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THE STATUS OF THE ALGO-LICHEN HYPOTHESIS.

BY THOMAS A. WILLIAMS.

IN treating this subject it will not be out of place to give first a short history of the growth of knowledge concerning lichens and their structure. The earlier lichenologists knew but very little of lichens as now understood, and comparatively nothing as to their internal structures. As the magnifying power of microscopes was increased, so the knowledge of the lichen thallus was increased. The affinities of lichens to the discomycetous fungi on the one hand and to the algæ on the other were early noticed and commented upon, and some species have been alternately placed among the fungi, then among the lichens, and others have been repeatedly changed from lichens to algæ, and vice versa. Later authors, as Cornu and Tulasne, consider the lichen very near if not belonging to the Ascomycetes, while De Bary, Krabbe, and others place them among the Ascomycetes without any doubt as to that being the proper place for them.[1] Lately Cora and several other genera have been placed among the lichens under the name of Hymenolichens—*i.e.*, lich-

[1] Stahl found the reproductory organs of Collema to be very similar to those of the Discomycetes. Borzi confirmed Stahl's observations by his own. Fünfstück, after a study of the development of the apothecia of Peltigera and Nephroma, believed that "the reproduction is by apogamy, with rudimentary sexual organs, as in Podosphæra among the Discomycetes." De Bary says (Morph. and Biol. of Fungi, etc.): "The formation of the perithecia of lichens from the primordial coils of hyphæ follows in general the same course as that of Xylaria, Polystigma, etc." This is confirmed by the observations of Krabbe, Füisting, and others who have made an extended study of the Cladoniæ, Sphyridium, Lecanora, Lecidea, etc.

ens which, according to Johow, are made up of the hyphal elements of a hymenomyceteous fungus and an alga. Massee claims to have discovered a Gasterolichen. So that now we have lichens placed among the Ascomycetes and the Basidiomycetes, and by good authority.

Wallroth (1825) was the first to make any study of the gonidia. He was followed by Koerber (1839), who studied them more fully than did Wallroth. But not until 1851 was made anything like an explanation as to their probable origin and subsequent growth. This was done by Bayrhoffer. He asserted that the gonidia came from the "fibrous stratum, the fibres of which swelled at the top and produce male gonidia." Speerschneider, who was the next to study the gonidia, differed from Bayrhoffer on some points, but agreed as to their probable origin. Schwendener, in his earlier works, took a similar view, basing his argument on the fact that the gonidia, many of them, seemed to be connected with the ends of the hyphæ. De Bary, in his work of 1865, agreed with Schwendener as to the heteromerous lichens, but in case of such species as belong to the Collemaceæ, etc., he said: "Either the lichens in question are the perfectly developed states of plants whose imperfectly developed forms have hitherto stood among the algæ as Nostocaceæ and Chroococceæ, or the Nostocaceæ and Chroococceæ are typical algæ, which assume the form of *Collema, Ephebe,* etc., through certain parasitic Ascomycetes penetrating into them, spreading their mycelium into the continuously growing thallus and becoming attached to their phycochrome-containing cells." This gave to Schwendener the idea of *dualism* which he afterward formulated and presented to the world. Such was the beginning of the much-debated "Algo-Lichen hypothesis." Schwendener in this famous theory declares that all lichens, so-called, are dual organisms, consisting of a fungus, parasitic upon an alga, whole colonies of which it envelops with hyphæ. These algæ he divides into two classes, Phycochromaceæ, or those with bluish-green coloring matter, phycochrome, and Chlorophyllaceæ, or those containing chlorophyll. The first of these he divides into five types: 1, Sirosiphoneæ; 2, Rivularieæ; 3, Scytonemeæ; 4, Nostocaceæ; 5, Chroococceæ. The latter he separates into three types: 1, Confervaceæ; 2, Chroolepideæ; 3, Palmellaceæ. To some one of these types, he claimed, the gonidia of every lichen could be referred.

About this time Famentzin and Baranetzky by cultivating the gonidia of several lichens (*Physcia* [*Theloschistes*] *parietina,* etc.)

produced zoospores. These in time developed into unicellular algæ, and by judicious management they produced several generations. Although they drew different ideas from this the Schwendenerians immediately took this as an argument for the dualism of lichens. Later (1872) Woronin confirmed the observations of Famentzin and Barentzky by his own experiments made with *Parmelia pulverulenta.*

When Schwendener propounded his theory one of the first to accept it was E. Bornet. He immediately began a series of observations and experiments to prove it. In his treatment of this subject (*An. de Sc. Nat.*, vol. 17, ser. 5) he divides his observations into two divisions corresponding to those of Schwendener—*i.e.*, those made upon lichens with chlorophyll-bearing gonidia, and lichens with phycochrome-bearing gonidia. Under the chlorophyll-bearing gonidia he found those belonging to such genera as Trentepohlia, Phyllactidium, Protococcus, Cystococcus, Pleurococcus, etc. He found the gonidia of several of the Opegraphæ, as *O. varia*, to be Trentepohlia. The branches of the alga were found ramifying the tissues of the bark, frequently going so far that the hyphæ of the lichen-fungus could not follow them. As they near the outer surface of the bark the hyphæ and algæ became more and more interlaced until they reached the thallus proper. When studied at all ages of the thallus the nature of the relations between the two were easily seen to be such as to preclude every chance of the one being developed from the other. The study of other lichens with similar gonidia, as *Verrucaria nitida, Rocella phycopsis, Chiodecton nigrocinctum*, etc., led to the same conclusions.

The gonidia of *Opeg. felicina* he found to be a Phyllactidium. The broad thallus of this alga was so large that the hyphæ did not entirely envelop it, but by gradually branching, surrounded parts of it and even sent small branches *into* it. He found in an old thallus of *Opegrapha varia* the normal filaments of Trentepohlia together with sporangia, showing that it could not be the "first stage of the lichens," but was an entirely separate plant. He sowed the spores of *Physcia* (*Theloschistes*) *parietina* on *Protococcus viridis*, and found that the hyphæ of the germinating spores readily enveloped the algæ, and did not envelop any other objects with which they came in contact. He also sowed spores apart from the algæ, and although germinating and producing hyphæ as did the others, they produced no gonidia and died as soon as the nourishment from the spore was consumed. He obtained similar results with *Biatora muscorum.*

As to those lichens containing phycochromgonidia, he found that Colothrix furnished gonidia for *Lichina pygmæa* and *confinis;* Scytonema and Lyngbya were found in such genera as Pannaria, Erioderma, and Stereocaulon (Cephalodia); Nostoc was found in Collema and allied genera; Etigonema in Ephebe, Spilonema, etc.; and Glœocapsa in Synallisa, Cora, Omphalaria, and similar genera. Sometimes he found the alga to be very little changed by the parasitism as in Ephebe and Spilonema; at others they were so changed as to be recognized only with difficulty. Two modes of contact were noticed: 1. Where the hyphæ are applied simply to the surface of the algæ, as in Peltigera, Stictina, etc. 2. Where the hyphal branches enter the algal cells, as in Physcia, Omphalaria, etc. From these observations he draws the following conclusions: that since Trentepohlia, Phyllactidium, etc., are so complex in their nature, and since no instance of the hyphæ enlarging and producing them has been found, and since these algæ (Phyllactidium, Trentepohlia, Nostoc, Protococcus, etc.) are found in the free state, there can be no doubt of the dual nature of those lichens containing them, and that, 1st, all gonidia can be referred to some algal type; and, 2d, the relations between hyphæ and gonidia are such as to exclude all possibility of one being produced from the other, and the theory of parasitism alone can explain these relations satisfactorily.

Reess made a series of cultivations with spores of *Collema glaucescens* sown with *Nostoc lichenoides.* By careful manipulation he produced a complete Collema thallus, but lacking the fruits. He saw the germinating spores "send out hyphæ which branched and forced themselves into the Nostoc."

Treub used the gonidia of one species of lichen and the spores of another. His success was similar to that of Reess

Stahl uses the hymeneal gonidia and spores of *Endocarpon pusillum* and spores of *Thelidium minutulum.* He succeeded in producing a fully developed thallus, showing that these hymenial gonidia are ejected at the same time as the spores, to serve as gonidia for the young plants. He cultivated these hymenial gonidia separately, and found them to grow and divide just as do the undoubted unicellular algæ. Lately Bounier has succeeded in producing a complete lichen thallus with mature fruits by using lichen spores and algæ.

Among the botanists in the United States who have favored Schwendenerism in their later works are Dr. Asa Gray, Dr. Bessey, H. Willy, etc.

Most of the English lichenologists, together with Koerber, Nyland-

er, and Th. Fries, oppose the theory of "dualism of lichens." There are, however, several different ideas as to the origin of the gonidia, Fries holding one opinion, Nylander another, and Crombie, taking a mean between the two, seems to believe either. Muller supports the "micro-gonidia" theory of Dr. Minks, as did the lamented Professor Tuckerman. Nylander, while acknowledging the external similarities between lichens and ascomycetous fungi, asserts, as does Crombie, that there are too many differences between them to admit of their being placed together. "The hyphæ of lichens." he says, "are perennial, tough, thick-walled, straight, and insoluble in hydrate of potassium, while the hyphæ of all fungi are soft, thin-walled, flexuous, immediately dissolved in hydrate of potassium." Besides the "Lichenian reaction" is seen in all lichens and in none of the fungi. Both these points are denied by many eminent lichenologists and fungologists. De Bary has found the "Lichenian reaction" in several undoubted fungi. Hartog, de Seynes, etc., say that fungal hyphæ are no more soluble in hydrate of potassium than are lichen hyphæ.

Nylander also speaks of the "improbability" of the lichen hyphæ being endowed with the reason and sagacity necessary to search out a peculiar kind of algæ which it may imprison and press into service." [1] He further urges, as does Crombie and others, that no algæ will grow in such bare, exposed places as those chosen by most lichens. Cooke, who uses this same argument, says further that those lichens that do grow in low, wet places, as Collema, etc., are by some authors supposed to be algæ themselves and therefore should not be used in an argument for Schwendenerism. Nylander, however, takes an opposite view and places many of the algæ of Schwendener and Bonet, etc. (such as Sirosiphon, Scytonema, Stig nema, Nostoc, Trentepohlia, etc.) among the lichens, as he has found fruits upon them. But he finds no hyphæ. From these discoveries he argues that even if there is parasitism, it is not that of a fungus upon an alga, but rather of a lichen upon a lichen. He was one of the first to place Cora among the lichens.

Crombie says that finding and producing of zoospores in free gonidia does not prove that gonidia are identical with algæ, but that they are *only similar to them.*

The autonomists raise quite an objection as to the relative size of

[1] Why is it that any parasite, either vegetable or animal, is generally limited to but one or at most to but a few species upon which it feeds?—Heredity, etc.

"Parasite" and "Host," and insist that there can be no such a thing as a "mutual benefit" parasitism in nature as is claimed to be present in case of the lichen-fungi and the algæ. The latter objection Sargent explains (*Am. Mo. Mic. Jour.*, Feb., 1887) by saying that while the algæ furnish the necessary nourishment for the fungus, the latter in turn protects the former from excessive dryness and sunshine, allowing only enough softened light as is necessary to decompose the carbon dioxide, and, by acting as a sponge, takes up water readily and retains it, thus insuring at least a moderate supply of water for the algæ even in dry weather; moreover, it is a well-known fact that fungi in growing give off carbonic dioxide. This the lichen hyphæ furnish to the algæ, and they in turn give back oxygen, etc., to the hyphæ. As to the fact that some lichens grow in comparatively dry places, he thinks that this is not a very serious objection, since in some lichens we have hymenial gonidia which are ejected together with the spores; in others soredia, by means of which new plants can be formed without the aid of spores. Again, the species of algæ supposed to act as gonidia are those species that have become adapted to the frequent dry spells incident to terrestrial life. He further insists that the differences between the fungal-algal elements of a lichen and free-living fungi and algæ are just those differences that would result from the parasitical relationship claimed by the dualists.

Nylander says that in no case do the gonidia arise from the hyphæ, but from the parenchymatous cortical cells observed by him in the prothalline filaments of germinating spores. Crombie formerly held that the gonidia might come from the hyphæ or the hyphæ from the gonidia. Later, he says the gonidia are of thalline origin. He claims to have seen the germination of spores and growth of young lichen thalli on rocks, etc., where no algæ or gonidia could be seen. At first only the young hyphæ were seen. Later, gonidia were found. These he believes to have originated in certain glomerules noticed on the young hypothallus. These glomerules he claims contain gonidia in various stages of development. They finally become thicker and form the cortical layer. He then uses Nylander's explanation as to the free state of the gonidia in the interior of the thallus: "The cortical stratum gradually increasing and extending is at the same time dissolved (resorbed, physiologically speaking) beneath, and the gonidia consequently become free." Crombie says further that "the contact between the hyphæ and gonidia is in no way genetic or parasitic. . . . The gonidia are

neither adnate to or penetrated by the hyphæ, but only adherent to them by the lichenin. . . . In all cases the apparent union is simply amylaceous adherence, and the fancied penetration the result of erroneous observation." He says that Stahl's observations are of no account, as he is a very careless observer, etc.

Koerber, who is one of the best of observers, while he opposes Schwendener, admits that "the germinating spores must have free gonidia belonging to the same species in order to develop a complete thallus," but that "these gonidia are not algæ belonging to the lichens as a fungus, but *gonidia* previously separated from the thallus and which have become 'asynthetic.'" He practically admits the whole thing.

Hartog says, speaking of Crombie's arguments, that he either utterly ignores the strongest points in favor of "Parasitism" or laughs at them and says "improbable," or that they are the result of "poor work" and "erroneous observation." To use a favorite Cookian phrase, both Cooke and Crombie answer many of the best arguments in favor of "Dualism of Lichens" simply by "rhetoric."

It is a noticeable fact that in a new country where new groves of trees are being planted, before the trees show any signs of lichens they are covered, especially on the north side, by "green slime," and the thicker the "green slime" the more rapid is the growth of the lichens when they do appear. Again, it is noticeable that when lichens begin to grow on fences and trees they take the dampest, coolest, shadiest places first, and gradually, if it all, extend to the dryer places, as seen on fences where boards cross the posts, where the lichens may be seen to extend a short way from the post along the centre of the board, avoiding the dry, windy edges. Our largest lichens are almost always found in the darkest woods. These facts show that lichens in general are not the "lovers of light, dry places," as one author claims. But on the contrary, while they do not choose such places as do the saprophytic fungi, they generally choose places where plenty of the lower algæ are to be found.

Most of the botanists who have made any experiments with spores, gonidia, and algæ have obtained results conclusive enough to convince them that Schwendener is right.

In conclusion, we now have lichens belonging to the Ascomycetes, the Hymenomycetes, and the Gastromycetes, according to most of our latest and best authors. The gonidia are pretty conclusively proven to be algæ, notwithstanding Crombie's "rhetoric;" and the

parasitism of the fungus hyphæ on the algæ has not only been shown to be possible but quite probable, and to be the only way to explain the peculiar relations existing between hyphæ and algæ satisfactorily. Schwendenerism, like "The Heterocism of Rusts," may be considered as a settled fact, and our "beloved lichens" must sooner or later be placed among the fungi, where they rightly belong.

The University of Nebraska, Dec., 1888.

AMONG THE ANCIENT GLACIERS OF NORTH WALES.

BY F. JOHNSTON EVANS.

THERE are few spots in the British Isles which present so many attractions to the geological tourist as that most picturesque of localities into which the traveller by rail from Holyhead is suddenly ushered when the "Wild Irishman" express, which had been rushing at the rate of some sixty miles an hour across the Island of Anglesea, after emerging from the Menai tunnel, somewhat abruptly pulls up at Bangor station. Around on every side are piled strange rock formations, tilted and upturned in every conceivable fashion. Within a comparatively short distance are the famous slate quarries of Penrhyn, in themselves a beautiful study; while in nearly an opposite direction are visible the lofty summits of Snowdon and Cader-Idris. Let the reader accompany me in imagination into the midst of this magnificent mountain region, our special object being to wander and speculate, for a brief space, among the ancient glaciers of North Wales. Proceeding through the Vale of Llanberris, we perceive, lying high above the road, near the top of the pass, a huge block of stone which has long attracted the notice of even the least observant traveller. It is perched on the edge of a rock a few hundred feet above the bottom of the valley, on its northern flank—that is to say, on the left hand of the traveller who is ascending the pass. It is from fifteen to twenty feet long, and six or seven feet high, sharp and angular as on the first day that it was detached from the parent mass. It rests on a face of rock which, for a few feet, slopes sharply towards the valley beneath, and then ends in a perpendicular face of rock, and it is so lightly poised on its narrow base, that

a finger-touch would seem sufficient to dislodge it from its precarious position. The thought involuntarily occurs, how came it there? What agency could have transplanted it thither without rounding or breaking off a single corner, and left it where it stands, with so cautious and gentle a hand that it rests securely not at the edge but on the side of a steep and smooth incline? It is utterly impossible that it could have rolled thither; for if so, the momentum which carried it to its present position, must have precipitated it down the cliffs below. In all probability, any force which could have moved it three inches from the top of the incline on which it rests would have been sufficient to send it crashing down to the bottom of the valley. Hardly any traveller can have passed up the vale—from one part of which this rock forms a very conspicuous object—without having had some such thought presented to his mind. Those, however, who are aware that the existence of a great glacier in this valley at some remote period is a geological certainty, will be at no loss to recognize in this rock a remarkable and most characteristic specimen of those transported blocks whose occurrence in various parts of the world, at great distances from the parent formation, was so long a mystery to the philosophic inquirer, but which are now recognized as among the surest indications of glacial action.

Climbing now from the high road to the block I have been describing, we perceive that it is only one—although much the larger—of a great number of similar blocks, which are deposited in the same manner on the sides and at the edges of the sloping or precipitous faces of rock which flank the northern side of the Vale of Llanberris. The greater part of these extend in a well-marked and tolerably regular line, and at elevations varying from 300 to 500 feet above the course of the stream, for perhaps a mile further down the valley—until, in fact, its sides become too steep and precipitous to admit of such deposits being made. Clambering along this side of the valley, we examine the faces of the rock around and beneath these blocks, and find many of them—especially such as have not been exposed to the action of the water-courses which trickle down here and there into the stream below—deeply scored with the characteristic striæ of glacial action. If we now cross to the opposite or southern side of the valley (the flank which lies beneath Snowdon), we shall find all the indications of glacial force—the deep notchings of the striæ, the polished and rounded surfaces which continental geologists term *rochers moutonnés*, and the transported blocks poised

in the most critical manner upon slopes which seem too steep to give them support—still more clearly and unmistakably exhibited.

The transported blocks and glacier scratches in the Vale of Llanberris are so well known to geologists that I simply refer to them to call to the mind of the reader the general aspect of the phenomena which I am about to describe as occurring in other parts of the Snowdon district, where they are not so well known, or so universally ascribed to the action of an extinct system of glaciers. Just at the top of the Vale of Llanberris, there is a hollow in the profile of the ridge which forms its northern boundary. It lies exactly between the cluster of houses called Gorphwysfa on the south, and the lake of Cym-ffynnen, at the base of the two Glyders, on the north. A few hundred yards to the east or southeast of the lowest part, at a distance of not more than 300 yards from the great block of the Vale of Llanberris, there is a little round knoll of rock which rises by itself above the neighboring parts of the ridge. It is something like an inverted basin, so that the ground falls away pretty steeply on either side, and the top is nowhere less than fifteen or twenty feet higher than the surrounding parts. Perched on the very top of this knoll, resting on three points of contact at most, is an irregular piece of rock, of a different formation from that upon which it rests, seven or eight feet long, three or four broad, and as many high. It has never been subjected to any process of abrasion or rounding, for every corner is perfectly sharp and angular—presenting in this respect a marked contrast to the rock on which it rests, which is round and smooth, and somewhat weather-worn. What could have brought this block to its resting-place? To have rolled thither it must have rolled some twenty-five feet up-hill, from whatever direction it had come. The ridge, for some hundreds of yards on either side of the knoll, rises but gently, and presents an undulating surface, along which a sharp oblong, irregular block of stone could by no possibility have preserved for any distance a considerable velocity: and between this knoll and the spur of the Glyder Fawr—the only considerable altitude within a mile of the spot—there is a hollow at least 150 feet in depth. But a little below the top of the knoll, on its eastern slope, is a still more remarkable block. It is about the same size as that which is seated on the summit of the knoll, and similarly sharp and angular, but consists of a coarse conglomerate of a very marked and peculiar kind, in which large round white pebbles, apparently of quartz, are imbedded in a kind of matrix, which looks like a coarse red sandstone. The

most incurious person can hardly fail to be struck with the great difference between the character of this rock and the clay slate upon which it rests. If the observer casts his eye around him, he will be unable to see in any direction traces of a similar geological formation in the neighboring rocks. A few feet further on, however, he will observe a third angular block of stone, larger than the others, but resting, like them, upon two or three points alone. He can hardly fail to be struck with the fact that these three blocks are in as exact and regular a line as if their places had been laid down by the nicest measurement. They run nearly northwest and southeast —about half a point to the west of N. W. and to the east of S. E.— that being the general direction of the ridge which descends from the spur of Glyder Fawr.

If we now remount to the top of the knoll, we shall perceive that the side of the steep inclines towards the hollow referred to before, is dotted here and there with large blocks of stone resting gently upon the sloping rock, or imbedded in the turf. All these, on examination, will turn out to possess the same sharp and angular character ; and all of these suggest the question : Is it possible they could have rolled so far up hill ; and were it possible, could they be as sharp and unrounded as they are? Still, however, we see no sign of the red conglomerate. As we pursue our way northwest towards the spur of the Glyder, we find the ridge growing rapidly steeper, but still we see this regular line of sharp blocks, deposited often on their sharpest edges, and nearly on the edge or backbone of the rock. As we mount, they become larger and more frequent, and amongst the higher rocks are one or two small fragments of red conglomerate—until at length, just behind a huge mass of clay-slate of a size which would do credit to any moraine in Switzerland, we come suddenly upon a block of conglomerate fifteen feet long and ten feet high, large enough and sufficiently overhanging to afford us no mean shelter from a Welsh mountain storm. Five minutes' further climbing in the same direction brings us to a most gratifying sight—a large patch, seventy or eighty yards wide, of the red conglomerate *in situ*—of exactly the same character in every respect as that which we first observed resting on the side of the clay-slate knoll some two miles away. Looking back we shall be able to trace distinctly the line of stones by which we have been guided in our ascent. It is so regular that they might almost have been dropped one after the other by a railway train. On each side of the principal line of stones we may observe other

though less regular lines, by which we may very nearly map out the exact extent of the ancient moraine to which they belonged. The last deposited blocks are not a hundred feet higher than the outcropping of conglomerate ; and we are now standing nearly upon the brink of the huge lake of ice which must have filled up the bason of the Glyder Fawr and the Glyder Fach, and poured out through the opening above the well-known little inn of Pen-y-gwryd into the valley of Gwryd, and terminated in the open space of the wide valley. Many of the rocks on the southern side of the opening, just above the lake which now occupies the bottom of the hollow between the two Glyders, present the general appearance of glacier-rounded rocks. But the material is so soft, and therefore so ill adapted for preserving the minuter and more indisputable marks of glacier action, that it would be unsafe to draw conclusions from their configuration, were they not supported by the independent testimony of the old moraine, which, with the exception perhaps of the moraine of the great glacier that filled up the whole basin of Snowdon, is the best defined that we may see in North Wales. The southern side of this hollow—forming the northern flank of the ridge along which lies the moraine of the Glyder—is also of a soft and easily disrupted stone, and much covered with turf and mould ; and accordingly we are unable to find any very distinct marks of striæ. The places where the rock is least covered and has been least exposed to the obliterating action of trickling water, are the places where such indications could not be expected to exist—namely, near the top of the ridge, and on its southern flank, high above the Vale of Llanberris.

It is not easy to say to what system the great block in the Vale of Llanberris belongs. An attentive examination will show that it lies higher than the well-defined line of deposits which extend along the same side of the valley. Indeed, it is considerably above the level of the actual crest or col of the pass ; and there is no precipitous or disintegrated height in its immediate neighborhood from which it could very well have been detached. Indications appear to be not wanting that the great glacier of the Glyder, at some remote period, rose above the lowest part of the hollow in the ridge toward the Vale of Llanberris, and overlapped the southern flank of the ridge. If so, this block, instead of belonging to the Llanberris glacier proper, is really a contribution from the stones of the Glyder glacier, and was brought down upon its surface from some

of the precipitous heights near the outcropping of the red conglomerate. Of this, however, it is difficult to speak with confidence.

We shall now select a new, and possibly a still more interesting route. At the head of the valley of Nant Francon, towering above Lake Ogwen and the high road from Bangor to Capel Curig, is the sharp and rugged peak called Tryfan—the most precipitous summit and the finest single mountain in North Wales. It is separated by a short, sharp ridge, running nearly north and south from the range of the two Glyders. Tryfan is an irregular continuation of this ridge, terminating abruptly on the Bangor road, and forming the western, as a spur of the Glyder Fach forms the eastern flank, of the romantic and secluded valley known by the name of Cwm Tryfan. The general level of this valley is considerably higher than the road, from which it is little seen, and as the approach to it is over broken and boggy ground, its very existence is unknown to multitudes of those who pass from day to day within a few minutes' walk of the spot. Yet it is one of the most curious in Wales. The explorer, on rounding the shoulder of Tryfan, comes suddenly upon a deep valley of gentle and tolerably regular inclination, half a mile wide and a mile and a half long, full, from one end to the other, of rounded and polished rocks of the most marked and characteristic aspect. They exist, not by the dozen, but by the hundred, and crop out from the moist turf all along the bottom of the hollow and to the height of several hundred feet along its sides. They are found up to nearly the same elevation along both sides of the valley, and above a well-defined line they cease altogether. Sometimes they are mere rounded knolls protruding through the turf and peat, but many of them are broad slabs and walls of living rock, hundreds of feet in length, every corner and angle of which has been carefully and elaborately rounded and polished off. More perfect specimens of the *rochers moutonnés* it would be hardly possible to imagine. Below the level of the glacier boundary, a sharp rock is not to be found, from one end of the valley to the other ; and the vast number of the rounded knolls and shoulders, together with the general coincidence in their forms and in the directions of the polished surfaces, affords conclusive proof that they were subjected to the action of one uniform, regular and constant force. The glacier which filled up this valley must have been, like the glacier of the Aar in Switzerland, remarkable for the evenness of its surface, and for the uniformity of its motion. It must have been almost a *normal* glacier —for there are no sudden contractions of its channel, no anomalous

elevation of its bed. The direction of its flow must have been very nearly uniform, from its origin just beneath the ridge which connects Tryfan with Glyder Fach to its termination in the broad valley which the Capel Curig road pursues. Such a confirmation is unfavorable alike to the development of a large moraine and to the existence of that excess of pressure against the sides and bottom of the glacier which causes the deepest striations of the polished surface : and hence these indications cannot be expected to be found of so striking and unmistakable a character as in the "Cwy Dyll," the great hollow of Snowdon, with its irregular bed and contracted orifice, or in the narrow outlet of the gorge of Aberglaslyn. Nor is the rock of a kind favorable to the preservation of the minuter traces of glacier action. Still, some may be seen of a peculiarly interesting and instructive nature. The extreme regularity of the bed of the glacier, the unusual absence of all disturbing or anomalous conditions, has given rise to the formations of striæ of great length and regularity. Some of those which score the rounded rocks on the southern flank of the valley are as much as fifteen or twenty feet long, and very distinctly marked. They are the more interesting as they intersect the line of stratification, and are crossed at right angles by the superficial markings caused by the dropping of water. From the upper end of the valley the view is very striking. If we stand by the shore of the ancient sea of ice which has now melted from the sight, we can define with precision the limits which bounded it on every side, and look down upon a succession of worn and rounded surfaces, which though upon a smaller scale, are hardly less curious or characteristic than the old glacier bed of the Höllenplatte, which is crossed by the traveller from Meyringen to the Grimsel.

While one considerable glacier thus poured from the eastern base of Tryfan, one of immensely greater extent—so long, indeed, that it would bear comparison with some of the existing glaciers of Switzerland—streamed down to the northwest, occupying for many miles the valley of Nant Francon. This glacier had its origin in the romantic amphitheatre of rocks and precipices which surround Lake Idwal, one part of which is well known as the "Twll Du," or "Devil's Kitchen," and extended for at least five miles down the valley towards the spot on which Bangor now stands. The rounded and striated rocks which still tell the history of this glacier are to be found in considerable abundance, and of very characteristic form and aspects, all along the Vale of Nant Francon. No better speci-

men of a *rocher moutonné* exists in Switzerland than is to be seen on our left hand, as we are descending the valley, at the bridge just below Lake Ogwen, and within a few feet of the road. On the other side, the rocks rise precipitously above the road, and the glacier must have been borne with great force against the wall of rock which there checked its progress and altered its direction. Although the rock is not of a very durable kind, it is conspicuously rounded to a height of some 250 feet, where the limits of the glacier level are apparent. The upper rocks overhang the lower, and are very rough and jagged, with a trace of rubbing. Below the road on the left hand, terrace after terrace of rock is rounded and smoothed. This is the part of the valley where the glacier traces are most prominent and striking. Here, they actually obtrude themselves upon the eye, but they do not cease for many miles. The gently descending line of the glacier level may be easily traced from the road along the opposite side of the valley, the smoothing action being the more apparent from the contortion of some of the strata, as seen in the upper and unworn faces of the rock. Between five and six miles from Bangor is a very interesting group of rocks which crop out from the turf in a little wood above the road. They formed somewhat of an elevation in the glacier bed, and have consequently been subjected to severe pressure. They are worn very round and polished quite smooth, and the striæ are most distinct, passing sometimes up-hill, over the undulating surfaces.

The most striking evidences of glacier action, however, are to be found in the great hollow of Snowdon, which is literally full of them. From some distance above the Copper Lake, almost to the bottom of Nant Gwynant, they stare at us in the face at every step. The "Cwm Dyll" was one vast mass of ice from whose bosom the peak of Snowdon rose to the height of some 1000 or 1200 feet at most. Grib Goch, Grib-y-ddysgyl, Snowdon, and Lliwedd formed an amphitheatre of mountain peaks enclosing the great Snowdon glacier, as the chain of the Aiguille Verte and the de l'Echand guard the Jardin and the glacier du Talèfre; names doubtless more familiar to American travellers than those of the subsidiary peaks in the Welsh mountain ranges. A large proportion of the rock in the basin of the Snowdon range is very hard and smooth, and has preserved, in singular freshness, even the minutest scratches. It is curious to trace, as we descend from the summit of Snowdon into the bosom of the hollow, the gradually diminishing inclination of the glacier and its increasing pressure, as marked by the dimin-

ishing slope and deeper *intaglio* of the striæ. The moraine also of this glacier is wonderfully perfect. The cart-road from the now abandoned copper works is cut partly through the lateral and terminal moraines; and the sections might, save for the different geological character and the smaller size of the blocks, be that of the ancient moraine of the Mer de Glace between Les Tines and Lavanchi in the valley of Chamouni. There is the same utter absence of sorting in the disposition of the materials, and the same angularity in individual blocks—the whole being cemented together by a fine deposit of grit and sand. To use the words of Professor Forbes, in his description of the Chamouni moraine: "We find the mound to be almost entirely composed of detached fragments, rough and angular, or only rounded by partial friction, and accumulated in the utmost disorder, mingled with sand, without any appearance of stratification." Among the fragments of stone exposed by the cutting are some very interesting ones. They have originally belonged to the bed, or to the containing wall of the glacier, much higher up, from which they have been detached after being highly polished and deeply striated; and being now uncovered, they display the notchings and scourings, not, of course, in their proper and original directions, but just as they happened to have fallen when the stones were deposited in the places they now occupy.

It must have been a strange scene of desolate magnificence that North Wales presented at the epoch I am writing of. There were Snowdon and his associated peaks, the centres of one vast system of glaciers, pouring down on every side, east, west, north, and south—the Vale of Llanberris choked with ice, and fed from the heights and recesses on either side—a great glacier, taking its origin in the deep basin between Snowdon and Lliwedd, streaming up the valley of Nant Gwynant, diverted a mile or two above the site of the sleepy little hamlet of Beddgelert, by the opposing rocks at the lower extremity of Llyn y-Ddinas, and at length struggling through the narrow gorge of Aberglaslyn, rounding and scoring its rugged sides to the height of hundreds of feet. Another great glacier probably descended through the deep inlet which reached from below Llanberris to the very heart of Snowdon, extending to within four or five miles of the present coast line, and leaving records of its passage which to this day are apparent on every uncovered surface of rock along the Llanberris and Carnarvon road. Nor did the Snowdon glaciers, though the greatest, constitute the only glacier

system in Wales. It is certain that from the group of the Glyders and Tryfan, no less than three glaciers—one of vast extent—poured into the vales and plains below; and probably round every peak or group of nearly equal height, and whose masses are broken up into those deep hollows and amphitheatres which are so favorable to the collection of a reservoir of snow—and, in a climate of variable temperature, to the consequent development of glaciers—similar ice-streams must have filled up the valleys and choked the gorges in every direction. The great peculiarity of this scenery must have been the small elevation of the peaks and mountain ranges above the general level of the glaciers. In Switzerland the summits commonly tower for thousands of feet above the highest parts of the highest glaciers, properly so-called; and the great glacier basins and reservoirs are commonly bounded by huge aretes of bare and rugged rock, specked only with snowy deposits, such as the ranges which hem in the glaciers de l'Echand, the central tributary of the Mer de Glace, or which block up the extremities of the glacier of the Aar and the lower glacier of Grindelwald. In Wales, the corresponding heights must have been measured by hundreds, instead of thousands of feet, for many of the glacier basins themselves lie high; and in this respect, despite the magnificent effect of such a wide expanse of snow and of broken and crevassed ice, the difference must have been unfavorable to the grandeur of the scenery. Something of the same kind may be seen in the northern glaciers of Norway, though the heights which surmount them are higher above the glacier level than was probably the case in North Wales, and there is no reason to suspect the existence in Wales of those vast fields of snow whose aspect and distinguishing peculiarities are so essentially different from those glaciers, and which give to the scenery of Norway a character so unique and extraordinary.

THE FOOD OF THE OWLS.

BY W. S. STRODE, M.D.

A FEW years ago Pennsylvania, Ohio, and some of the more eastern States enacted laws offering a bounty of fifty cents per head for all hawks and owls that should be killed.

This munificent bounty aroused the professional hunters, and for the time being legitimate game was abandoned in many sections of

these States for the more remunerative business of hawk and owl shooting. Thousands were killed and the Raptores seemed in a fair way to be exterminated.

This merciless slaughter arrested the attention of ornithological and scientific societies, and they at once set to work to devise means to check the work of destruction.

Committees and individuals were appointed to investigate the food habits of the hawks and owls. Hundreds of dissections of stomachs were made, and after a thorough research the following report was made :

"*Resolved,* That the hawks and owls are of great benefit to the farmer and render him far greater service than injury, and that it is unwise to select any of them for destruction."

This report was concurred in by the leading naturalists throughout the length and breadth of the land, and as a consequence these obnoxious laws have been repealed.

A partial exception was made against the Sharp-shinned Hawk, Coopers' Hawk, and the Great-horned Owl.

It is to the latter bird that I will mainly give attention.

As the eagle heads the list of the diurnal birds of prey, so is the Great-horned Owl the most noble of the nocturnal birds, and the ancients chose well when they assigned to Minerva this bird as the emblem of wisdom.

Owing to a suitable habitat probably more of these owls are to be found in the Spoon River country of Central Illinois than in any other section of like limits in the United States. From my boyhood to the present they have always excited within me a lively interest and curiosity.

Their unsavory reputation as chicken thieves has led to their being destroyed whenever possible, and as a consequence in many parts of the country where they were once quite common they are now extinct.

This bad reputation and consequent destruction of this owl, in my experience and observation, is not all deserved.

Many times when a lad have my slumbers been broken in upon by my mother's voice calling up the stairway, "Get up quick ! an owl is after the chickens." A careful investigation would reveal the intruder perched in the top of an apple-tree or on a limb close by the side of an old hen that would be waking the echoes of the night with her squalling. The owl in the meantime would be bowing and swaying his body to and fro, occasionally uttering a low

hoo! hoo! hoo! seemingly regarding the whole performance as a huge joke.

Unfortunately for the owl, this comedy would sometimes be quickly turned to a tragedy by a load from my shotgun, bringing him to the ground, and perhaps the hen also.

The principal food of the owl in the Spoon River country consists of small rodents, and the gray rabbit furnishes the greater part of it. Reference to my note-book for the years 1887–8 shows the following:

March 20, '87. Found a Bubo's nest in a large red oak tree, forty feet to first limb, seventy-five to nest. A tremendous climb, but with the aid of a splendid pair of climbers I got up to it, finding it occupied by a trio of downy baby owls of different sizes, who tried to look very fierce at my intrusion. In the nest with them was a whole rabbit and parts of another.

March 27, '87. Great-horned Owl's nest in white oak tree, standing in a steep hollow. Could see young birds from hillside above. An easy climb to the nest found it containing two half-grown young and half of a rabbit.

March 30, '87. Discovered a Great-horned Owl's nest in a cavity of a soft maple tree, thirty feet from ground. Found in it three young and parts of several rabbits.

March 31, '87. Located a Bubo's nest in an elm snag fourteen feet high, standing on a creek bank. Found in the nest three young owls with their feathers turned wrong end to, snapping their bills wrathfully and looking the very personification of fierceness. The largest of the three was half-grown, while the smallest was near the size of a quail.

In the cavity was one whole rabbit, the hindquarters of another, a flying squirrel, and a quantity of fish-scales. While I was sitting on a limb by the side of the cavity, watching the little fellows, the parent owls suddenly appeared upon the scene, and I had a cyclone about my ears for a few minutes. Such a whirl of feathers, claws, fierce eyes, snapping beaks, hootings and screechings about my head was calculated to terrorize one unaccustomed to the actions of this, the greatest of all the owls.

After continuing these demonstrations for a few minutes, one of them, the male I supposed from his coarse voice and white crescent under the chin, settled down upon a limb a few feet from the ground just over the creek.

His manner now underwent a change. Swaying to and fro for a

short time, he fell off the limb to the ground, and then tumbled about in the leaves in an apparently very crippled and helpless condition. My dog, that had been sitting all this time in a perfect frenzy of excitement at the foot of the stub, watching the owl, now forgot his training and made a headlong rush through the creek for the owl, but it was up and away, leaving him disappointed and crestfallen. I returned to the ground and departed, leaving this interesting family to the enjoyment of their well-furnished larder.

I subsequently learned that these young Bubos came to a tragic end. Some boys, finding them in the stub, threw them out into the creek, where they were worried to death by their dogs.

March 28, '88. Found a Great-horned Owl's nest containing two young owls, parts of a rabbit, and a flying-squirrel. Nest in a cavity in a soft maple.

March 29, '88. Bubo's nest in top of a white oak tree. An old nest of Red-tailed Hawk, two small young owls, a whole rabbit, and a half rabbit—a great deal more rabbit than owl.

March 30, '88. Nest in a wild cherry tree. A crow's nest preempted and reconstructed. Contained one young owl, a rabbit, a flying squirrel, and a robin. This is the only nest in which was found the remains of any bird.

Last spring, while out hunting Bubo's nests, I found a dead Screech Owl lying on the upper side of a broken plum tree limb. Its back, from the neck to the tail, was as neatly laid open as it could have been done with a sharp knife. I credited this piece of wantonness to the Great-horned Owl.

One bright day in March, '87, I was returning from a professional call. At this season of the year, when the hawks and owls are nesting, it is my custom, when not hurried by business, to leave the highways and ride haphazard through the woods, regardless of fences, hills, hollows, or creeks.

On this day I was riding leisurely along through heavy timber, down "Johnson's Creek," when my attention was arrested by the noisy cawing of a large flock of crows on the hillside two or three hundred yards to my right.

I at once guessed the cause of all this tumult to be a Great-horned Owl, for of all the denizens of the forest none other will so arouse the uncontrollable indignation of the family Corvidæ.

I had not thought of disturbing this camp-meeting of the crows, until suddenly a regular pandemonium of shrieks, and directly the scurrying by of a number of the sable birds, each one

shouting bloody murder at the top of his voice, plainly told me that something terrible had happened in the dark woods on the hillside above. Turning my horse loose, I went noiselessly up the hillside on a tour of investigation.

Presently a large Bubo flew up from the ground a few rods in front of me, and upon going to the spot I discovered the cause of the sudden great consternation of the crows The owl had wreaked summary vengeance upon one of his tormentors, and the smoking body lay upon the ground in two halves, having been divided transversely instead of lengthwise as in the case of the Screecher. A part of the viscera had been devoured.

Last spring, while wandering about in the woods on "Geetur Creek," a tributary of the Spoon, I was attracted by the barking of my dog, and on going to him, found a young Bubo that had fallen out of the parent nest. It was in a little creek bed, and the parent owls had nicely concealed it by covering it up with leaves.

I decided at once to make a pet of it. A few days later I took from a family of four in a hollow sycamore a half-grown Barred Owl (*Syrnium nebulosum*), and placed it with the first, with the intention of studying and comparing the habits and dispositions of the two birds.

They are now full grown and have indeed proved to be very interesting pets. They have the run of an outhouse that gives them plenty of room to fly about in. They have become very much attached to each other, and if one is removed from their apartment the other is inconsolable until its return. And then such a bowing and nodding to each other is ludicrous indeed. The disposition of the two birds is very dissimilar. The Bubo is by far the nobler bird —as tame as a cat, good natured and intelligent, pleased at the appearance of familiar faces, but suspicious of strangers. Always greets my appearance at the door of the owl-house with a low hoo! hoo! hoo! followed immediately by a shrill screech or at times almost a quack. Greatly enjoys having his head scratched; shuts his eyes, and his voice will sink almost to a whisper.

The Syrnium is just the opposite; untamable, sneaking, revengeful; suspicious alike of everything and everybody. Anything from mussels to cats is relished as food. Fat or tallow they will not touch. Mice, rats, ground-squirrels, kittens, chicken-heads and small birds are first thoroughly crushed by their beaks and are then usually swallowed whole. Before swallowing birds they first pluck out their feathers.

It is said that if an owl once gets a taste of fish he is a fisherman ever afterwards, and of this fact I have seen many demonstrations.

At Thompson's Lake, on the Illinois River, I have several times in the dusk of the evening seen the Barred Owl feasting on discarded fish. The shutting down of the water-gates of the mill often leaves many small fish stranded on the gravel bed of the river, just below my house, and I have many times witnessed a pair of Great-horneds fly down from the trees on the opposite bank to feast upon them.

During the summer months small fish formed the staple diet of my pair of pets, and a pound of shiners three times a day was about the amount they required.

Their manner of feeding is very different. When a canful of minnows is poured out to them the Bubo will jump into their midst, and, as my boy sometimes remarks, "Just hog them down," two at a time.

The Syrnium will pick out a particularly lively minnow, eye it for a moment, then spring upon it and grasp it in the talons of one foot, and after holding it for a few seconds quickly transfer it to his beak, after which he will gaze about defiantly for a short time and then swallow it.

This bird has developed a great hatred for the boys, probably as a result of their disposition to guy him whenever an opportunity offers. This dislike has lately taken shape by his making a dive at every boy that enters his house, raking the top of his head with his claws as he passes over him, and then giving vent to his peculiar, laughing cry of "Who ! hoo ! hoo are you !" This trick he has played so often on the "gamins," that, at present, not one of them can be induced to enter his apartments.

Some days ago a venturesome lad laid his eye up to a knot-hole in the side of the owl-house to take a peep at them. His lusty screams quickly brought me from my office to his side. The blood was running freely down his cheek. The aim of the Syrnium had been unerring. From his perch on the opposite side of the building he had made a dive for the eye, and running one foot through the hole had lacerated the skin badly, but luckily not injuring the eye.

Sometimes I put a live rabbit in the owl-house, and then there is fun to see the Bubo getting up courage to attack it. No bully ever gave better evidence of a mixture of cowardice and bravado. He will bow and sway his body to and fro, run along his perch and back again, look to me for encouragement, then bow, look at the rabbit and bow, all the while uttering his shrill scream, which becomes

more and more fierce as his courage rises. Finally, after assuring him that he is a brave fellow, and no coward, to go for it, etc., he makes the attack. And now his whole nature suddenly changes, and instead of a hesitating bully he more nearly resembles a raging lion.

It is said that the tiny Downy Woodpecker more nearly resembles the great Ivory-billed than does any other of the many species of the family Picidæ.

The same may be said of the Little Screech and the Great-horned Owl, the little Scops being a tiny image in action and appearance of its great relative, from whom it probably evoluted.

In the spring and summer of 1887, at the request of Dr. R. W. Shufeldt, U. S. A., I was making a collection of nestlings of representative American birds, that was to be sent to Prof. Parker, of London, to be utilized by him in his great work on "Avian Osteology." Among the many birds brought to me by my boy collectors was a family of four young Screech Owls. Downy little fellows, all beak, claws, and eyes. Wishing to use but one of them as an alcoholic specimen, I was at a loss what to do with the others, as the nest from which they were taken was on a creek five miles away. I finally concluded to adopt them, and a family of kittens, which they resembled in many respects, would not have proved more interesting and trusting pets.

From first to last small fish was their main diet, and it was amusing, indeed, when their food was brought, to see the downy little fellows rush and tumble over each other in their eagerness to get at it. If a mouse was given to them it would first be put through a bone-breaking process and then swallowed. Small birds would be thoroughly picked and then swallowed head first.

After they became able to fly about, they were taken from the box in which they had been kept and put into the apple trees growing in my yard to shift for themselves. But they refused to shift; on the contrary, seemed to consider themselves as a part of the family, and for weeks remained about the yard, and in the dusk of the evening would come at once on being called, sometimes from the mill a hundred yards away, or from the trees across the river.

A very interesting feature connected with these little Scops was the manner in which they were treated by the other birds of the vicinity. About once a day the birds would assemble to harass and scold them, the usual time being a little before sundown. At a signal, generally from the Robin, they would come from all direc-

tions—the Jay and the Purple Grackle from their nests in the apple trees; the Rose-breasted Grosbeak from the top of the hackberry; the Cardinal and Wood Thrush from the box elders across the river; the Orioles from their swinging nests in the elm and sugar maple; the Bee Martin and Warbling Vireo from the silver-leaved; the Jenny Wren from the eaves of the portico; the Cat-bird and Brown Thrasher from the gooseberry bushes, and the Maryland Yellow Throat from his nest in the thick weeds on the river's bank—all would come to devote a few minutes to scolding their common enemy.

The Jay, the Grackle, the Cat-bird, and the Robin would do the aggressive business, while the other birds, from a respectful distance, would be the spectators. The Robin, in particular, would show the greatest excitement in these attacks. He would often fly down to the ground near where I sat and in the most frantic manner try to call my attention to the fact that there was a terrible owl in the apple tree.

At first these attacks almost frightened the Screechers to death; but they soon became accustomed to them, and, in fact, seemed rather to enjoy this bird matinée.

One of these interesting birds was stoned to death by a man as it was perched upon the fence near his repair-shop. Another was shot and killed by a *kind-hearted* lady that wished to display her marksmanship. A third is still about town, and his tremulous notes are often heard around my premises in the dusk of the evening.

PRIMITIVE ARCHITECTURE.

I.

Sociological Influences.

BY BARR FERREE.

FOOD and shelter constituted the first and chief wants of primitive man, and to their satisfaction he devoted his dormant energies. At first, unable to construct his own shelter, he was obliged to depend upon such as nature furnishes. The *cave* was at once the most convenient and the safest. Its universal use in primitive times

is attested by the vast number of remains and relics we find therein. Its use by the Rock Veddahs—one of the rudest races of mankind—has continued to the present day. History, however, furnishes other reasons for the use of the cave. Thus hermits affect them that they may be uncontaminated by worldly things, and the fi-her-man of the Yank-tse still uses them, as they are most convenient for his occupation.

As man became more accustomed to his surrounding, as his ideas became stronger and more definite, he set about building his own shelter. At first it was a mere pile of leaves and branches. If subject to a constant wind, he arranged a semi-circle of branches thrust upright into the ground, and often built a fire in the open side.[1] In a more advanced stage he builds a circle of branches, brings their tops together, and ties them with a strip of bark. But the hut is still incomplete, and remains so until the frame is interwoven with cross-branches and twigs, sometimes, as with the Fuegians, only on the windward side, sometimes, as with the Damaras, over the whole.

The shed has an origin equally early as the hut, although it was developed differently. In fact it depended on the material on hand whether this form or the other was adopted. In Australia,[2] where large strips of bark are readily obtained by the natives, a lean-to is the usual form; in Fernando Po.[3] on the other hand, a coarse matting stretched out on four poles is in universal use. The latter may be considered the normal form of shed. and we can trace its progress from these slightly inclined roofs to the elaborately finished, high-pitched roofs of the hot regions of South America.

The early habitations of man may be roughly classified as circular and rectangular. Much speculation has been indulged in as to the causes of this difference, and it is a singular fact that the two styles of dwellings are frequently found side by side in districts where there does not seem to be a natural cause for any distinction. It has been suggested that rectangular houses are characteristic of the communistic manner of living and circular ones of single families. The members of a single family can readily sleep around one fire; when several families are congregated under one roof several fire-places are required, and the house is extended, usually in one direction. While this is true, there are many circular houses occupied in common, and there are also numerous instances among the rudest

[1] Tasmanian Journal, i., 250.
[2] Angas's Aust. and N. Zealand, ii., 212.
[3] Allen and Thompson's Narrative, ii., .197

peoples of one family occupying rectangular dwellings. The truth is, that the development of both the rectangular and the circular house is merely a plain case of natural development. First, we have a simple breakwind, a single strip of bark. Then comes one on two sides, another is added, and it is only necessary to close the remaining side to complete the square. These changes can be illustrated by numerous examples, but it is only necessary to mention two; the breakwind of the Australian savage represents the first stage, and the Patagonian tent,[1] formed of skins stretched on three sides of a square, the second. The shape of the dwelling does not, as might be supposed, depend on the manner in which the logs forming the sides are laid. When horizontal, we invariably have the rectangular hut, but they are placed vertically in both rectangular and circular dwellings. Nor is the explanation difficult, for the shed, supported by upright poles, is easiest enclosed by placing logs parallel to the first, and the rectangular house with walls of vertical logs is obtained.

The manner of life is an essential element in determining the form and character of a dwelling. In the earliest times man was constantly moving, seeking new shelter, new resting-places, new food. He could carry nothing with him in his migrations, for he had no means of conveyance. He was equally satisfied with a cave or a heap of leaves. Later, when he has learned to use a few simple tools, to skin animals, to prepare their skins, and to build his hut with some little care, he carried it with him. Hence the dwellings of nomadic peoples fall naturally into the two divisions of transportable and non-transportable, and the former are again subdivided into those covered with mats and those covered with skins.

Dwelling of Nomads	non-transportable	
	transportable	Mats
		skins

Being easy of construction, mat tents are used by the rudest peoples. The Abipones pass their lives under two poles and a mat; the Zulus, standing higher in the social scale, find comfort in cages of pliant sticks, covered with finely woven rush mats.[2] Skin tents are used by more advanced races, since their use implies knowledge of the manufacture of the weapon with which to kill the animal, and of the mode of skinning and preparing the skin. They are

[1] Anthro. Jour., i., 197.

[2] Burchell's Travels in Africa, ii., 198.

used alike both by pastoral and hunting tribes, but seldom by purely agricultural ones, by the hunting Indians of North America, the Dakotas and Chippeways, by the pastoral bands of the extreme east and the far south, the Arabs and the Patagonians.

The agricultural nomads, moving less often than do the hunting and pastoral ones, build more permanent dwellings. Some, as the Gonds, move every few years. Their houses are of wattle and daub, thatched with teak-leaves ; within are two rooms, separated by a row of grain baskets, or by a bamboo screen, one serving as a living room, the other for storing.[1] Greater care is shown by the Bodo and Dhimals,[2] who, in addition to the central dwelling, build a cattle-shed ; and if the family is a large one, complete the quadrangle with two other dwellings. The Santals,[3] moving only when they have exhausted the soil at one place, build even a more elaborate group of buildings ; a verandah is placed at the gable end, and pigstys, buffalo-sheds, and dove-cots built within the common enclosure.

Many other causes than the fertility of the soil occasion the removal of the agriculturist. The Khonds[4] abandon their dwellings on decay ; the Western Karcens[5] seek new quarters on the encroachment of their enemies ; while the diseases generated by the heat expel the Caribs from theirs.

Turning to communism, which is, perhaps, as early a phase of life as the nomadic, we find that it also produces numerous variations in structure. And, first of all, it is interesting to trace the origin of communism as shown in the dwelling. The protection gained by numbers led many tribes to adopt this form of life. Such, for example, are the Pueblo Indians,[6] who erect large terraced buildings, often with no opening on the ground floor. Such, also, are the Mandans,[7] an unaggressive people, brave, but unable to contend with their powerful neighbors, the Sioux. Their houses are circular, from 40 to 60 feet in diameter; the walls are of thick logs, the roof of beams supported by posts, thatched with willow-boughs and prairie grass, and the whole covered with several feet of earth and clay. Two doors of buffalo skin protect the entrance.

[1] Forsyth, Highlands of Central India, 99.
[2] B. H. Hodgson in Jour. As. Soc. Bengal, xviii., 741.
[3] Jour. As. Soc. Bengal, xx., 570.
[4] Macpherson, Report upon the Khonds of Ganjam and Cuttack, 59.
[5] Parrish in Jour. As. Soc. Bengal, xxxiv., 145.
[6] Morgan, 136.
[7] Ib., 126.

In addition the whole village is fortified. To the same cause may be attributed the peculiar villages of the Tupis, which consist of several houses arranged with their entrances opening on a common court, and the whole surrounded with a strong palisade.

The greater facilities communism affords for obtaining subsistence led the Iroquois to adopt that form of life. Those residing in villages lived in common, all partaking of the common store, while the venturous brave who went out after food lived a solitary life. To the same reason may be probably attributed the all but universal custom of communism among the North American Indians. The natives of Guiana furnish a curious variation of the women and children living in a detached cook-house.

In the far north cold has produced communism. The desire for greater warmth induced the Kamtschatdales, the Ostyaks [1] and the Esquimaux [2] to live in common during the long, cold months of winter, while light cool dwellings suffice for their abode in summer.

In studying the effect of communism on the structure of the dwellings, we note, first, that all communistic houses are very much larger than those intended for single families. They are of all sizes, from the Ojibwa wig-e-wam [3] for two or three families, up to the immense Long House of New Guinea, 30 x 300 feet and more, or the American Pueblo of a thousand rooms. As the size varies with the number of the inhabitants, so does the construction. The greater the number of people engaged in erecting a building, the greater the care taken and the better will be the materials used. Such is found to be the case with the dwellings of the Clatsops and Chinooks,[4] the walls of which are of white boards sunk in the ground, with a roof of timber fastened by cords of cedar bark and covered with two or three ranges of light poles. The Long House of the Seneca-Iroquois is another example. It is formed of a strong double frame of poles, with either a triangular or a semi-circular roof, enclosing large strips of elm bark, tied to it with strings or splints.[5] The Esquimaux furnish even a more striking instance, for the huge blocks of snow and ice used in their dwellings cannot be moved without the assistance of many men. The great care taken in the construction of communal dwellings is further shown by the use of

[1] Latham's Des. Eth., i., 454.
[2] Cook's Sec. Voyage, ii., 237.
[3] Morgan, 113.
[4] Ib., 111.
[5] Ib., 120.

larger material than is possible or even desirable in individual dwellings, as is shown in the huge pieces of bark covering the Ojibwa wig-e-wam, and the Iroquois Long House. Finally, it should be noted that communism sometimes produces remarkable changes in the appearance of the dwelling. Perhaps the most noteworthy instance is the village of the Yakut nation of Southern California,[1] consisting of a row of conical or wedge-shaped wig-e-wams, with a continuous awning of brushwood in front.

Although the changes produced by communism are of a limited nature on the exterior of the dwelling, it causes a great variety in the interior. First of all, we note variation in the number of partitions and in their construction. Some dwellings, as those of the Dakotas and of the Tupis—the latter containing from 20 to 30 families—are without any partition whatever. Others, as those of the Chinooks, have partitions in the larger houses—80 families—but none in the smaller. Then come partial partitions; some, as in the elliptical lodges of the Kutchin tribe, radiating towards a central open space; others, as in the Iroquois Long House, having side partitions only. Finally, there are complete partitions, separate cabins under the same roof. These last are found in the houses of New Guinea,[2] huge edifices containing cabins of bamboo 10 feet square, with doors at the side and a fireplace between every two cabins. The Mishmis,[3] with similar dwellings, have a fireplace in each compartment.

Quite as much variety is found in the distribution of the passageways. First, none at all, as in the Kutchin lodges; next, a straight aisle down the middle, as in the Iroquois Long House. Differing from this only in position are the houses of the Mishmis, with a passage along one side, and the Kareens,[4] who form a passage all around the house. Finally, there is a perfect maze of passages, as in the dwellings of the Brokpas.[5]

A similar evolution is found in the arrangement and number of the fireplaces. Many, as with the Powhatans and Dakotas, the Kutchins and the Mandans,[6] have but a single fire in the centre of the dwelling. Others, again, as the Iroquois[7] and the Uraupes,

[1] Morgan, 107.

[2] Jukes, Narrative of the Surveying Voyage of H. M. S. Fly, 272.

[3] Griffith in Jour. As. Soc. Bengal, vi., 333.

[4] Mason in Jour. As. Soc. Bengal, xxxvii., Pt. 126.

[5] Jour. As. Soc. Bengal, xlvii., Pt. 1, 34.

[6] Morgan, 126.

[7] Ib., 65.

arrange the fires in the central aisle, so that one fire serves for four cabins. More developed are the dwellings of New Guinea, with a fire to every two cabins, and of the Mishmis, with a fire to each cabin. Another form is found among the Mayas, who build a separate cook-house where the cooking for the whole village is done. The Ostyaks keep their food safe from the dogs in a village storehouse.

There is no more singular mode of building than that of elevating the dwelling on poles. It is of most frequent occurrence among communistic peoples, but is by no means confined to them. Its origin has been long a favorite subject for controversy among students of primitive architecture. The historians of Timor allege that it arises from the fear of the reptiles that infest that fertile island, and we are also informed that such houses are constructed at Kurrecchane that the children may sleep safely at night. However well this custom in these places may be explained by these statements, it is sufficiently obvious that the explanation is not a universal one, and its origin must be looked for elsewhere. The best theory yet proposed is that of M. Frederick Troyon,[1] but which, though it is supported by many facts, fails when put to the test of universality. Beginning with the observation that all such buildings are built over or near water, M. Troyon argues that the rafts used in the early migrations afforded little protection to their owners, especially when the men were off hunting. Safety, however, was readily obtained by mooring in midstream, while, when pulled ashore, the raft was best kept from being washed away by the waves, by being elevated beyond their reach. Unfortunately for his theory, however, M. Troyon has ignored the fact that elevated houses are to be found both on the coast line and in interior districts where rafts would be impractical. Other and possibly many causes have contributed to the custom ; among them especially the desire for greater protection. It is not sufficient for the Sumatrans[2] that they hide their dwellings amid the trees on a hill-top, to which there is but one, or at most two, narrow paths of access, nor is a high and strong fence enough. They elevate their houses on posts and enter by means of movable notched poles. The theory of protection is confirmed by the solitary houses being more elevated than are the village houses. If the custom of building elevated houses

[1] Troyon, Habitations Lacustres des temps anciens et modernes. Lausanne : 1860.

[2] Marsden, History of Sumatra, 56.

originated with the natural fear of man for his race, then, in houses built over the water, the land side should be the strongest portion of the building, while the water side should be open or only lightly constructed. This is found to be the fact in the houses of New Guinea,[1] which have a stage on the water side that affords a convenient place for keeping the canoes. A confirmation of this explanation is seen in the custom of many maritime tribes of placing their dwellings where embarkment is attended with the greatest difficulty. Again, this mode of building is found prevalent among both warlike tribes, as the northern Kareens, and peaceful ones, as the Mishmis. All such instances point in the direction of the same cause; that they may better defend themselves against their enemies.

But greater protection is not the sole reason for the building of elevated houses. High floods make it imperative, as with the Waraus, or else drive the natives to elevated bits of land, as in the basin of the Orinoco. Tribes living near the coast and supporting themselves by fishing adopt this style of dwelling almost exclusively, while interior tribes prefer houses built directly on the ground. This distribution is especially marked in the East Indies.

Besides acting as an integral factor in producing communistic and elevated dwellings, the desire for better protection has brought about many other variations in structure. The location of the village is frequently selected with this end in view. Sometimes the hill-top is chosen, as by the Maiwar Bhils—who have a back door conveniently arranged for flight; with others the most secluded valleys are sought, as is done by the Santals;[2] others, again, hide their dwellings in clumps of trees. Some, also, as the Khonds,[3] place their villages in close proximity to each other, while the Bushmen[4] take the opposite course of building in high open spots where they cannot be attacked without warning.

A suitable site selected, the next step is to defend it. This leads to a judicious arrangement of the dwellings; a favorite plan being a circle with the entrances opening towards the central space, which is usual among the Andamese, the Bushmen, and the Kaffirs. When the chief of the village has developed into an important personage, his dwelling, for greater safety, is placed in the centre of the enclosing village. The Rajput and Bihé villages are illustrations of this fact.

[1] Forrest's Voyages, 95.
[2] Jour. As. Soc. Bengal, xx., 569.
[3] Campbell, Wild Tribes of Khondistan, 49.
[4] Burchell, Travels into the Interior of Southern Africa, ii., 55.

The mere arrangement of the houses does not, however, furnish sufficient protection to the timid or the warlike tribes. Artificial fortifications must be raised. These are of two general kinds, those intended for the whole village and those only for single houses. The former include palisades, sometimes erected at the end of the street, as in the Khond villages, and as is usual in Africa, sometimes continued around the whole settlement, when it becomes a wall. The second class includes a great variety of expedents, dependent, chiefly, upon the ingenuity of the builder. Some, as in New Caledonia, are satisfied with building a fence close to their dwellings; others, as the Angain Nagas, surround themselves with a stone wall; others, again, as the New Zealanders, barricade their doors and windows with strong bars.

Rank and wealth have their influence upon dwellings. This is chiefly to be seen in their construction and size. The poor of every society, the lowest as well as the highest, live in meaner houses than do the wealthier classes. Not only will a rich man's house be larger than a poor man's, but in warm climates it will consist of more parts. The wealthy Kalmuck has a separate cooking tent, and the palace of a Javanese prince resembles a walled city.

Rank is further indicated by sundry external forms; for example, by the height of the dwelling, the elaboration of ornament, the shape and number of the roofs. The house of a Javanese chief has eight roofs, while the mass of the people are restricted to four.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

The American Society of Naturalists at its recent meeting in Baltimore passed a resolution which requests its Executive Committee to consult with the corresponding representatives of certain other scientific bodies as to the next time and place of meeting. The societies referred to are all newly organized, and are: The American Physiological Society, the Society of Anatomists, and the American Geological Society. One of these, the Geological Society, arranged to meet during the Christmas holidays at Ithaca, N. Y., and it was stated that several of the geological members of the American Society would probably prefer to attend the meetings of

PLATE XXI.

Part of the Cascade Range.

the Geological Society should they be held contemporaneously in future. It was also plainly seen that the multiplication of societies would reduce the membership of the body then in session at Baltimore, and a remedy for such contingency was proposed and discussed.

The proposition is that the four societies hold their meetings in future at the same time and place, so that the members of one of them can have the advantages of the others. The plan was generally acceptable to the members of the American Society, and it is to be hoped that it will be so to the other societies as well. Such an arrangement has much in its favor, and the only objection arises from the slight difficulty to be experienced in making the preliminary and local arrangements. The existence of so many societies necessarily diminishes the strength of each one, since few naturalists can hold, for various obvious reasons, a membership in more than one of them. The co-operation of these societies once obtained, the result will be beneficial to American science. It will be, in fact, a national scientific body intermediate in character between the National Academy and the American Association. Such a body will produce a distinct impression on the energies of its members, as well as on the attention of the public. If the membership is properly guarded, it will have a distinctly valuable influence on the administration of scientific trusts of all kinds. That the membership can be guarded we fully believe, since the American Association is the popular body and furnishes every opportunity for expansion in that direction. The new body would furnish a winter meeting for naturalists of all departments, under the influence of a festive season, in every way well calculated to encourage and stimulate them in their often locally isolated labors. We hope that the three societies named will take this view of the subject, and that next winter will see a combined meeting of all of them at some accessible point.

THE NATURALIST informs its readers that it commences the year 1889 with a new department, that of Bacteriology, under the editorship of Professor W. T. Sedgwick, of the Institute of Technology, Boston. The department of Physiology will be edited by Professor Frederick S. Lee, of Bryn Mawr College, Pa.

The numbers of the NATURALIST for 1888 were issued on the following dates: January, Feb. 3; February, April 2; March, April 21; April, May 25; May, June 29; June, Aug. 8; July, Aug. 30; August, Sept. 30; September, Oct. 24; October, Nov. 22; November,

Dec. 13; December, Dec. 26. Postal delays caused the omission of some plates from the December number. These will be issued with the January and other numbers of the present year. Haste in the printing of the December number caused the numerous typographical errors which it contains, and neither authors nor editors are responsible for them. The publishers have made new arrangements for printing, so that the delays in issuing the magazine to subscribers, and separate copies to contributors, will not again occur.

ERRATA.—In November number, p. 955, fourth line from bottom, for 1700 read 700. Do., p. 997, for 1,600,000 read 160,000. Do., p. 1029, for *Clione* read *Cleome*. In December number, p. 1073, for *Septocladus* read *Leptocladus;* do., Plate xxvii., for *facies* read *brevifacies.*

RECENT LITERATURE.

THOMAS' BURIAL MOUNDS.[1]—To one who, like the present reviewer, received most of his archæological knowledge at the feet of that most accurate student of the American Indian within the historic period, Mr. Lucien Carr, of Cambridge, Dr. Thomas' monograph appeared like an old friend. There is, indeed, much new material, and a new presentation of old facts, but there is, too, the same conclusion which we have been led to hold as true: that those mounds which dot our Western and Southern States and which have given rise to such an amount of speculation and hypothesis, were built by the Indians in possession of that region within the historic period or by their ancestors. The facts brought out by Mr. Carr in his essay on the "Mounds of the Mississippi Valley Historically Considered" have not been controverted, and the present paper but adds to the evidence that there is no necessity for invoking the aid of a special race of "Mound-Builders" distinct from the Indians found in possession of the eastern half of the United States at the time of its discovery.

Dr. Thomas takes up the subject in the following order: (1) Burial Mounds of the Wisconsin District; (2) Burial Mounds of the Illinois District; (3) The Ohio District; (4) The Appalachian District; (5) The Cherokees probably mound-builders; (6) Concluding remarks; while in a supplementary note he gives an account of the burial customs of the Hurons, translated from the pages of the martyred Brebeuf in the "Relaçion" of 1636.

In the cases of the mounds of Wisconsin as well as of those of the Illinois district (including Northern Illinois, Eastern Iowa and

[1] Burial Mounds of the Northern Section of the United States. By Cyrus Thomas. Extr. Fifth Annual Report of the Bureau of Ethnology. Washington, 1888, pp. 119.

Northeastern Missouri) it is clearly shown that the historic Indians did build burial mounds, but in the case of Ohio this is not so easy. History and tradition tell us almost nothing of the aboriginal inhabitants of that State, for soon after the advent of the French in the new world, the Iroquois rendered that whole region an uninhabited wilderness. It is true that we have references to the Eries or Cat nation and legends of the Tallegwi, but what the affinities of these tribes were, history tells us nothing. Dr. Thomas, however, compares the Ohio mounds with those near Charleston, West Virginia, and gives much evidence to show that both were made by the same people and more than suggests the identity of the Tallegwi with the Cherokees. These latter are shown beyond much possibility of doubt to have been a mound building people even in post-Columbian times. Among the other conclusions drawn may be mentioned these : That there is no evidence of human sacrifice in mortuary rites ; that nothing indicates that the people building the mounds had arrived at any higher culture-status than had some of the historic Indian tribes of the same region; and that the period of mound-building could not have continued for more than a thousand years, and hence its commencement probably does not antedate the fifth or sixth century.

Comstock's Entomology.[1]—This work is nearer our ideal of what a text-book of entomology should be than anything, American or foreign, which has appeared for many years. It is concise, clear, and bears evidence of careful preparation and abundant knowledge, while most of the illustrations are new and fresh, many being engraved by Mrs. Comstock expressly for the work. In the present part the subjects treated are (1) The Characters and Metamorphoses of Insects, (2) The Anatomy of Insects, (3) The Orders of Hexapoda, (4) Thysanura, (5) Pseudoneuroptera. (6) Orthoptera, (7) Physopoda, and (8) Hemiptera. In the second part (which we sincerely hope may not be long delayed) the remaining orders will be taken up, and with them we are promised chapters on economic entomology, directions for collecting and preserving insects, a bibliography, a glossary, and an introductory chapter.

In the treatment of the different orders we notice a lack of uniformity: in some analytical tables extending down to genera are given, while others are treated less fully. This is doubtless owing to the present state of entomological science. and those groups which are left in the more imperfect condition are just those where there remains work for the systematist. We are glad to see that only the Hexapods are included, for the Myriapods are at best an uncertain group, while recent investigations have shown that the Arachnida, aside from being Arthropods, have no relationships with either Hexapods or Myriapods. With the sequence of orders some fault might be found. A division of Hexapoda above Thysanura into

[1] An Introduction to Entomology. By John Henry Comstock. Ithaca, N. Y.: published by the Author, 1888. [Pt. I., pp. 234, with 201 figures.] $2.00.

Ametabola and Metabola is convenient, but it accords too high a rank to an adaptive feature. Complete metamorphosis is but a comparatively recent introduction in the life of insects, and with it as a basis forms closely allied in structure are necessarily widely divorced. Again, in our opinion, the Orthoptera are clearly lower than the Pseudoneuroptera, a view which is not negatived by palæontological evidence nor by embryology.

We notice a few slips which can readily be corrected in the promised introduction. On the first page the author writes "Vermes" where he clearly means "Annelida," and the unnatural group of Tracheata is referred to on the same page. On the seventh page chitine is stated to be deposited "in" the body-wall. On the eighth page it is stated that the eyes may possibly be modified legs, a view which is completely negatived by embryology. On the twenty-third page the sting of certain insects should have been stated to be a modified ovipositor. Perhaps the greatest omission of all is the absence of any account of the embryology of Hexapoda. Still these, with the exception of the last, are minor points, and this exception we hope to see rectified before the volume is completed. As a whole, the work is of great value. The illustrations and descriptions will make it a true guide to the young student of insects, the accounts of noxious insects will aid the agriculturist and horticulturist, and we venture the prediction that it will be the most often referred to of any book on the shelves of the working entomologist.

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GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

ASIA.—According to a letter in a recent number of the *Revista de Geografia Comercial,* the population of the Philippine Islands is very unequally distributed, since while there are sections which, without being the most fertile, contain 223 inhabitants to the square kilometre, other sections, and these among the most fertile, have only three or four inhabitants to the same area. According to the same periodical, the sanitary conditions of the port of Paraqua Island (*Puerto-Princesa*) have become much more favorable since the forest, which formerly extended to the coast, has been cut down for a width of six kilometres, and the cleared space has been occupied with plantations of coco palms, plantains, and cacaos.

Paraqua is the third in size of the Philippine Islands, and measures 445 kilometres in its greatest length, by 44 in its greatest width. Upon its coasts are many excellent and well-sheltered ports and bays, the principal of which are Vyalampaya, Puerto-Princesa, and Ulugan. A range of mountains, the culminating points of which are Montalingaban (2.080 m.) on the S., and Victoria (1.372 m.) more to the N., parts the island into two parts. Rich alike in fertile soil and in valuable woods, this island has hitherto been greatly neglected by its owners. Its population does not exceed 28,000—viz.: 10,000 Christians in the N.; 6000 Mahometans on the S., about 6000 Tachanuas, 500 negritos, 1500 tandalanos, and 4000 manguianes.

EASTER ISLAND.—The *Revista de Geografia Comercial* (Nov. 15, 1888) states that the Republic of Chili has resolved to annex Easter Island, which was discovered by Juan Fernandez, and which in 1470 was formally taken possession of in the name of King Charles III., of Spain. Easter Island is of triangular form; 35 kilometres in circuit, and its highest point in the extreme northwest is 597 metres above the sea. It is emphatically a land of extinct volcanoes; one of these is placed at each angle; Kau on the south, Horni on the north, and Utuiti on the east. There are many other smaller volcanoes. The volcano Kau has an elevation of 408 m. and its crater, which is 200 m. deep and 1500 m. in diameter at the bottom, is remarkable for the regularity of its shape. In the bottom of this crater there are springs of potable water and fine plantations of sugar-canes and plantains.

[1] Edited by W. N. Lockington, Philadelphia, Pa.

The inhabitants are probably not more than 200 in number. The average height of the men is 1.57 m., that of the women, 1.50.

Easter Island is celebrated for its gigantic statues which the natives call *moai*, and also contains ruins of houses, vast platforms, and cemeteries. The statues represent the upper part of the body as far as the hips, with the arms united to the sides, the hands embracing the hips, and the face with a disdainful expression. They are carved from a compact gray lava which abounds in the crater of Utuiti, but have crowns of red lava of conical shape and about three feet in height. Most of these statues are from fifteen to nineteen feet in height, but some are much larger, notably two which are stretched upon the ground near Utuiti. In one of these the body alone is 12 m. high, and the nose 3.40 m. The interior of the crater of Ronororaka contains forty of these statues, all with the face turned towards the north; and the summit of this mountain seems a great workshop of unfinished statues. One of the platforms, on the south coast, is .9 m. high, and 100 m. long, is enclosed with a wall, and contains numerous overthrown statues as well as some low columns which apparently served as altars. The cemeteries (Papakoo) are double platforms, the upper one containing sepulchral chambers. Wooden slabs with hieroglyphics exist upon the island, but no one can decipher them, so that the origin of the huge ruins is unknown. There is, however, great similarity between the statues and the sculptures of the Aymaras of Peru.

JAPAN.—According to the first official statistics published by the Japanese Government, the empire contains 381,845 square kilometres, and has a population of 38,151,271. The number of men greatly exceeds that of the women, and divorces are so numerous that they amount annually to 3 in every 1000 inhabitants. The mortality is low compared with that of most European countries, since it is only 19 per 1000. Japan has 721 towns with more than 2000 inhabitants, and five of more than 100,000—viz.: Tokio, 912,837; Osaka, 353,970; Kioto, 235,403; Nogoya, 126.898; and Kanakasa, 104.020. The production of tea each year is about 23,000,000 of kilograms and that of silk 3,000,000 of kilograms. The amount of rice, wheat, barley, sugar-cane, and other agricultural products, is such as to prove that either the soil is superior to that of Europe, or that it is better cultivated. The very considerable extent of forest that still remains may perhaps partially explain the fertility. Two hundred and fifty six telegraphic and 92 telephonic offices exist in the empire. A carpenter earns about 35 cents a day, a stone-mason about 44 cents.

AMERICA. CASSIQUIARE.—The *Revista de Geografia Comercial* dissects sarcastically the *discoveries* of M. Chauffanjon in the region of the Upper Orinoco. If the *Revista* is correct, and it certainly fortifies its assertions with names and dates, M. Chauffanjon's achievements are similar to those of the immortal Captain Glazier. The

Revista states that in 1743, the Jesuit P. Roman passed along the Cassiquiare from the Orinoco to the Rio Negro; that Diaz de la Fuente and Bobadilla followed the Orinoco nearly to its source and 87 leagues above the separation of the Cassiquiare; that the Marquis of Socorro, with Hurriage and other commissioners deputed to fix the boundaries of Brazil, found the latitude and longitude of the point of origin of the Cassiquiare, and calculated its altitude at 337 Spanish yards above sea-level; and that the mountains which M. Chauffanjon has rebaptized bear the title of Parima, though in different portions of their extent they are called Tapiraperú, Patuibiri, Arihuana, Maritani, Humirida, Pacaraima, etc.

GEOGRAPHICAL NEWS.—The principal articles of export from Spain, besides wine, are iron, copper, lead, cork, and oranges. The values of these articles during the first four months of 1888 were, according to the *Revista de Geografia Comercial,* respectively \$2,166,000, \$2,921,000, \$1,626,000, \$3,363,000, \$1,351,000, and \$1,783,000. The value of wine exported during the same four months was \$20,466,800.

A project to run a line of steamers between Vigo and New York has been set on foot by the Spanish Chamber of Commerce at the latter place. Vigo is only 60 miles further from New York than Queenstown, and is 231 miles nearer than Havre. The lower latitude, independent route, and comparative freedom from fog and wind, will more than compensate for the slightly increased distance.

The Manchester ship canal, now in course of construction, will be 35 miles long, the width varying from 170 to 260 feet at the top, a width at the bottom in no case less than 130 feet, and a minimum depth of 25 feet. The contract is let for £5,750,000, but the company has a subscribed capital of £8,000,000. The opening of this canal will practically make Manchester a seaport. As the city with its suburbs contains 850,000 souls and will be geographically the nearest port for 7,000,000 of people, the construction of this canal cannot but be injurious to Liverpool.

The province of Santandar, Spain, contains in operation 360 zinc mines, 312 iron mines, 30 lead, 19 copper, and 17 coal mines. Less than a fourth part of its area is cultivated, and rather more than a fourth is in pasture.

The population of Belgium, according to the census of Dec. 31, 1887, amounted to 5,974,000.

GEOLOGY AND PALÆONTOLOGY.

Fish Otoliths of the Southern Old-Tertiary.—In a recent article[1] Dr. E. Koken in Berlin describes the fish otoliths collected by Dr. Otto Meyer in the Old-Tertiary of Mississippi and Alabama. The locality "Jackson River" of Mr. Koken ought to be "Jackson, Miss.," and the locality "Newton, Miss.," cannot be considered as belonging to the Vicksburg beds. Changed accordingly, Mr. Koken's table of species is given below.

	Claiborne, Ala.	Newton, Miss.	Jackson, Miss.	Vicksburg, Miss.
Otolithus (Carangidarum) americanus......			+	+
" (Apogonidarum) hospes..........			+	
" (Pagelli) elegantulus............			+	
" (Sparidarum) insuetus............			+	
" (Sciænidarum) radians...........				+
" " gemma...........			+	
" " eporrectus........		+		+ and Red Bluff, Miss
" " claybornensis.....	+		+	
" " intermedius.......	+			
" " similis............			+	
" " decipiens..........	+			
" (Trachini) lævigatus............			+	
" (Cottidarum) sulcatus............			+	
" (Triglæ) cor....................			+	
" (Cepolæ) comes..................			+	
" (Mugilidarum) debilis............			+	
" (Gadidarum) meyeri.............			+	
" " elevatus............	+			
" " mucronatus........	+			
" (Platessæ) sector.................	+		+	+
" (Soleæ) glaber...................			+	
" (Congeris) brevior................			+	
" (incert. sedis) aff. umbonato......		+		

We see that Mr. Koken has succeeded in determining the genera or families of all fishes which are represented by these ear-bones, with the single exception of one worn specimen from Newton. The enumerated families and genera indicate a strictly litoral fauna, no abyssal form is among them. It is different in its character from the fish fauna of the German Tertiary, which has been studied also

[1] "Neue Untersuchungen an tertiaeren Fisch-Otolithen." Zeitschrift d. deutsch. geolog. Gesellsch., 1888, p. 274, 3 plates.

by Mr. Koken from the otoliths, but resembles in general the present fauna of the Gulf of Mexico, of the West Indies, and the Southern coasts of the United States. The dissimilarity of the fish faunas on both sides of the Atlantic existed, therefore, already during the earlier Tertiary. We are indebted to Mr. Koken for having developed an entirely neglected subject, the study and determination of fossil fish otoliths, to such an extent that important conclusions can be derived.—*O. Meyer.*

CATALOGUE OF FOSSIL REPTILIA AND BATRACHIA OF THE BRITISH MUSEUM Pt. I., by Dr. Lydekker. In this volume we have what has been long needed, a synopsis of the fine collection of British and such other European extinct reptiles of the orders Ornithosauria (Crocodilia), Dinosauria, Squamata, and Rhynchocephalia, which is embraced in the national museum of Great Britain. This synopsis is, like its predecessors, systematically arranged, and the text is enlightened with comments on the structural relations of the forms embraced in it. Many of the forms, especially of Dinosauria, described by English authors, have been hitherto in a state of obscurity to foreign observation, and a great deal is done in the present volume towards clearing this away. Especially valuable are the diagnoses of families and genera of the Crocodilia, in which the mesozoic formations of Europe are so productive. While we accord generally with the systematic views expressed by Dr. Lydekker, we must point out a few points of divergence. We cannot perceive the *raison d'etre* of an order Proterosauria, which the author, indeed, seems to regard as provisional. We do not believe that the Opisthocœla (Sauropoda) is distinguishable as an order from the Crocodilia. In nomenclature, we find the two divisions of the true Dinosauria to accord exactly with our own, and not with those of Professor Marsh, yet the names of the latter author are adopted. As usual, we find some generic names adopted, which were never characterized, as Trachodon instead of Hadrosaurus. Finally, we must make an appeal on behalf of the name Belodon for the genus usually so called, as against the prior name of Phytosaurus. Phytosaurus for an entirely carnivorous animal is a gross misnomer, and is nauseating to the scientific stomach. Not only this, but the typical specimen exhibits only mineral casts of the pulp cavities in place of teeth, so that name belongs to mineralogy rather than to palæontology. In case Belodon has been previously otherwise used, there are other available names, as Centemodon Lea, for instance.

In concluding this review, we must record our appreciation of the author's method of clear definitions for all divisions he proposes and adopts, a custom which is the necessary basis of all good taxonomic work.—*E. D. Cope.*

GEOLOGICAL NEWS.—GENERAL.—M. M. Bertrand (*Bull. d. l. Soc. Geol. de France,* No. 7, 1888) endeavors to reconcile the oppo-

site views of French and German geologists relative to the relations between the structure and age of eruptive rocks. While French geologists have, by long study of the eruptive rocks of France, come to the conclusion that their structure shows indubitable traces of the youth, maturity, and old age of the earth, the German school has from its studies concluded that there is no relation between the structure of eruptive rocks and their age, but that all varieties may have been produced at any time in the world's history. Mr. Bertrand believes that the fact that, in the Tertiary period, a series of ancient textures reappeared in consequence of the long period of repose that preceded that period, may be brought in to reconcile the two beliefs. If there was one such recurrence, others, greater or less, may have occurred from similar causes. Still, M. Bertrand believes that there are variations between these recurrences, and sets himself the task of explaining them.

"All the eruptions of the same period (in Europe) are grouped around their corresponding chain, the most ancient around the Caledonian or in the more northern regions; those of the Permian and Carboniferous around the Hercynian chain, those of the Tertiary round the Alps. If the entire globe is studied, at every age rocks of all compositions and structures will be found, which bears out the idea of the German school; but if the same zone is studied, details of structure in relation with the age of the rocks can be found."

M. Bertrand considers the continent of Europe to be formed of four zones each of which exhibits its series of folds. These zones are: (1) the Huronian, which has its principal European extension in Russia, Finland, and Sweden; (2) the Caledonian, which occupies Ireland, Wales, Scotland, and Norway, thus introducing itself wedge-like into the sinuous outline of the Huronian; (3) the Hercynian or Carboniferous, the northern edge of which, in both Europe and America, is marked by a line of coal measures; (4) the Alpine, comprehending the Pyrenees, Alps, Carpathians, and Balkans. By a curve in its outline the Hercynian mass takes in the Asturias and the central plateau of Spain. Mr. Bertrand gives diagrams of the distribution of the zones in Europe, of their folds, and of the masses of eruptive rocks connected with them, and enters into details regarding the separate masses.

Palæozoic.—Charles Barrois notes the presence in the Pyrenees of a species of Oldhamia found in the palæozoic schists in the department of Haute-Garonne. The new species is named *O. hovelacquei*. The presence of this species, distinct from *O. antiquus*, discovered by Oldham in Ireland in 1844, proves the existence of the Cambrian age in the Pyrenees.

M. D. P. Oehlert describes some Devonian Acephala (Aviculidæ) found in the Devonian strata of France. Three new forms of Pterinea, five of Avicula, one of Palæoneilo, and two of Modiomorpha are added to those previously known.

MESOZOIC.—M. Deperet (*Bull. Soc. Geol. France*, No. 7, 1888) treats of a brackish-water horizon in the Huronian; and describes a new species of Cassiope, one of Cerithium, and one of Corbula from it. The horizon occurs at La Mede and Callauch, near Marseilles.

M. H. E. Sauvage (*Bull. Soc. Geol. France*, No. 7, 1888) describes the reptiles of the Upper Portland series of Boulogne-sur-Mer. These include *Megalosaurus insignis, Iguanodon prestwichii Caulodon precursor,* a Dinosaurian not yet named; three chelonians, two crocodilians (*Machimosaurus interruptus* and *Goniopholis undidens*), an Ichthyosaurus near to *I. thyreospondylus,* and two Plesiosauri.

The Cretaceous region of the southwest of France presents (*Bull. Soc. Geol. de France*) characters strongly contrasting with those of the Jura, Pyrenees, and Brittany. The beds offer both vertical and horizontal continuity, the country not having experienced the disturbances of other Cretaceous basins. There is a considerable hiatus between the Jurassic and the Cretaceous of the southwest of France. The Wealden, Neocomian, Urgonian, Aptian, and Gault are absent, the Cretaceous sea did not invade this region until the Cenomanian period. The Turonian and Danian are present.

Louis Dollo (*Ann. Soc. Geol. du Nord*, July–Aug., 1888) states that *Pachyrhynchus* Dollo, *Erquelinnesia* Dollo, and *Glossochelys* Seeley, are equal to *Euclastes* Cope.

TERTIARY.—M. Gosselet (*Ann. Soc. Geol. du Nord*, July, 1888) disputes some of the conclusions of Prof. Prestwich regarding the correlation of certain Eocene beds of England with those of Belgium and the north of France, and proposes a table in place of that drawn up by Prof. Prestwich. M. Gosselet believes, contrary to the opinion of Prof. Prestwich, that the London clay is represented in the basin of Paris.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—In a recent number of *Tschermak's Mittheilungen*[2] Mr. Hyland gives a most interesting and detailed account of the lavas of Kilimandjaro, a volcano in eastern equatorial Africa, and of the rocks in its vicinity. Pegmatite, gneiss, amphibolite, basalt-obsidian. limburgite, nepheline- and feldspathic-basalts, tephrite, basanite, tufas, and other fragmental rocks are described. The basalt-obsidian was taken for andesite glass by Bonney,[3] whereas it really contains no augite—the mineral regarded as augite by Bonney being olivine. Among the limburgites three types are recognized. In one porphyritic olivine predominates over augite; in a second the olivine is subordinate to augite and hornblende; in the third hornblende is absent and augite is more abundant than olivine. The first and second kinds are closely allied to the feldspathic basalts, and the third to the nepheline-basalt. The olivine in these rocks contains a large number of inclusions of magnetite, augite, and spinel. It is zonally developed and is frequently surrounded by a rim of augite needles. The feldspathic basalts embrace hornblendic varieties, in which the hornblende is corroded and surrounded by an opacitic rim, composed of augite, magnetite, and olivine, and porphyritic varieties in which the large prophyritic crystals are anorthite. The nepheline-basanites are especially interesting because of the occurrence in them of anorthoclase so well developed that Hyland was enabled to determine its optical properties with great accuracy. This mineral is undoubtedly triclinic. Its extinction on the basal plane varies between 0° and $3\frac{1}{2}$°, and on the orthopinacoid between 5° and 6°. Its specific gravity is 2.63. Freed from impurities and analyzed it yielded:

SiO_2	Al_2O_3	CaO	K_2O	Na_2O	H_2O
61.3	23.1	3.02	5.34	7.11	.09

A leucite basanite contains almost ideally developed leucite crystals—the first discovered in Africa.[4] The other rocks described in the paper present no features of especial interest.—An important contribution to the study of the younger nepheline rocks has recently been made by Stock,[5] of the University of Leipzig, who has thoroughly investigated the material composing the basalt hills near Löbau, Saxony. This material comprises nepheline- and

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Min. u. Petrog. Mitth., x., p. 203.
[3] Report Brit. Ass., 1885, p. 682.
[4] Cf. Amer. Naturalist, Nov., 1888, p. 1024.
[5] Min. u. Petrog. Mitth., ix., p. 429.

plagioclase-basalt, and nepheline-dolerite. The latter rock has been classed by Rosenbusch[1] among the nephelinites because of the supposed non-existence of olivine in it. The nepheline rocks have been erupted since the beginning of Tertiary time and are older than the plagioclase-basalt, which occurs in them in the form of dykes. The normal constituents of the nepheline rocks are augite, olivine, nepheline, apatite, biotite, and magnetite. The dolerite contains these as idiomorphic crystals in a groundmass composed of microlites of the same minerals and plagioclase in a devitrified base. In the finer grained variety the nepheline occurs principally as the interstitial substance between the other constituents. In both varieties this mineral possesses a tendency to pass into natrolite, phillipsite, and stilbite. The olivine is often so filled with magnetite that its true nature can be distinguished only with great difficulty. Twins of this mineral parallel to $P\breve{\infty}$ are not rare. Apatite is abundant, and frequently contains inclusions of the groundmass. Rubellan was discovered in a large number of sections, and hyalite and aragonite were found filling druse cavities. Both varieties of the nepheline rock are regarded as portions of the same magma. The dolerite is over the basalt, and is supposed to have cooled first. Inclusions of it are common in the underlying rock. Foreign inclusions, found also in this rock, consist of augite and sanidine, of which the former is usually on the exterior. Other common constituents of these inclusions are hematite, green spinel, and orange-colored rutile. The plagioclase-basalt contains quartz inclusions surrounded by rims of augite crystals.—Prof. Judd[2] calls attention to the fact that petrographical classification is based on the qualitative and not the quantitative determination of the constituents of rock masses. He shows that rocks composed of the same minerals may have widely varying compositions, even when their groundmass is approximately the same. Five examples of hypersthene andesites having the same mineralogical composition are taken, and it is shown that their content of silica ranges from 51.8% to 70%. The fact that the same minerals are found in rocks possessing such differences in composition is explained by supposing them to have crystallized in the earlier stages of the rock's solidification and then to have been separated from the residual magma, and finally to have recombined with this in proportions different from those in which they first occurred. Since the residual portion is much more acid than the individualized portion, it is easy to imagine rocks of any degree of acidity to have been formed by the mingling of the two portions in different amounts. The effect of the presence of water in lowering the fusing point of a rock is also discussed, in relation to its bearing on volcanic phenomena.

Mineralogical News.—*Note.*—In the mineralogical notes for the current year the crystallographic axes will always be repre-

[1] Mikroskopische Physiographie, ii., 1887, p. 791.
[2] Geol. Magazine, Jan., 1888, p. 1.

sented by the italicized small letters, *a*, *b*, *c*, and the axes of elasticity by the italicized capitals *A*, *B*, *C*, the latter indicating respectively the axes of greatest, mean, and least elasticity.—*New Minerals.*—*Sulphohalite* is a transparent, pale greenish-yellow mineral, crystallizing in the form of a dodecahedron, that was obtained from a drill-hole at the depth of thirty-five feet below the surface of the alkaline deposit at Borax Lake, California. It was associated with *hanksite*, and only one specimen was secured. The only two other specimens known to exist are in the collection of Mr. Bement, of Philadelphia. The mineral has been examined by Messrs. Hidden and Mackintosh.[1] Its specific gravity is 2.489, and its hardness 3.5. Its composition is represented by $Na_2\ (\frac{3}{4}\ SO_4 . \frac{1}{4}\ Cl_2)$ or $3\ Na_2 SO_4 + 2\ Na\ Cl$. a formula analogous to that of the rare mineral *connellite*, which is thought to be a copper sulphato-chloride.—*Auerlite* is a new thorium mineral from the zircon mines in Henderson County, N. C. It is described by Messrs. Hidden and Mackintosh[2] as occurring in disintegrated granite and gneissic rocks, intimately associated with *zircon*, and frequently implanted upon this mineral in parallel position. The color of the new mineral on a fresh fracture varies between a lemon-yellow and a brownish-red. Its weathered exterior is of a dull yellowish white. It has a waxy lustre, is subtranslucent to opaque, and is very brittle. Its hardness is 2.5–3, and its specific gravity 4.422–4.766. In crystallization it is tetragonal with the simple P and ∞ P faces. Its composition corresponding to $ThO_2 \left\{ \begin{matrix} SiO_2 \\ \frac{1}{3} P_2O_5 \end{matrix} \right\} H_2O$ is :

$H_2O.CO_2$	SiO_2	P_2O_5	ThO_2	Fe_2O_3	CaO	MgO	Al_2O_3
11.21	7.64	7.46	70.13	1.38	.49	.29	1.10

Auerlite thus appears to be a *thorite* in which part of the SiO_2 has been replaced by P_2O_5—the first recorded replacement of this kind in mineralogical literature.—Two new *sulphantimonites* are reported by Mr. Eakins[3] from Colorado. The first was found at the Domingo mine, Gunnison County, in aggregates of small acicular dull grayish-black crystals in the cavities of a gangue composed of siliceous material and calcite. Its analysis yielded :

Ag	Cu	Pb	Fe	Mn	Sb	S	Gangue
tr.	tr.	39.33	1.77	tr.	36.34	21.19	.52

corresponding to $(Pb\ Fe)_3\ Sb_4\ S_9$. The second is also found in little groups of crystals, of a bright steely-gray color. The individual crystals are larger than those of the first mineral, and occur together with pyrite and sphalerite in a siliceous gangue. Their composition is $Pb_5\ Sb_4\ S_{11}$, resembling *freieslebenite* in which the silver has been replaced by lead. Analysis gave :

[1] Am. Jour. Sci., Dec., 1888, p. 463.
[2] Ib., p. 461.
[3] Ib., p. 450.

Ag	Pb	Fe	Sb	S (calculated.)
tr.	55.52	tr.	25.99	18.98

General.—Scacchi[1] has published a complete catalogue of the minerals occurring at Mount Vesuvius. He divides them into (1) crystallized minerals occurring in pieces of foreign rock cast up during the eruptions of Monte Somma and the earlier eruptions of Vesuvius; (2) those forming lava bombs ; (3) those occurring in the Monte Somma conglomerate, as a result of contact action ; (4) those produced in the fumaroles by sublimation ; (5) those formed in the lava during its cooling ; and (6) those present on the walls of the amygdaloidal cavities in the lava. One hundred and twenty five mineral species are briefly described, and the name of the writer first mentioning them is given. The catalogue will prove of great convenience to collectors in the region and to those in charge of collections embracing many Vesuvian specimens.—Brezina[2] would add *tellurite* to the group comprising the oxides *claudetite* and *valentinite*. Crystals obtained from a porous sandstone at Facebaja were measured and found to be orthorhombic with $a : b : c = .4566 : 1 : .4693$. The predominant faces are $\infty \breve{P}\infty$, $\infty \breve{P}2$, $\infty \breve{P}4$, ∞P and P, and the plane of the optical axes is $\infty \breve{P}\infty$.—In the limestone near Bagnères de Bigorre, France, are little crystals of black *albite*, which, according to Lacroix,[3] have the following composition :

SiO_2	Al_2O_3	Na_2O	CaO	Ign	Specific gravity
67.04	20.45	10.57	.65	1.30	2 563

—Limur[4] describes a *staurolite* crystal from Moustoir-Ac, Morbihan, France, which consists of a core, composed of quartz and staurolite material, surrounded by two zones of staurolite, one with a granular structure, and the other with a fibrous structure, due to the arrangement of little needles perpendicular to the prismatic faces of the crystal.

New Books.—Rutley's "Rock-Forming Minerals."[5]—This little volume constitutes an excellent book for beginners in the study of microscopical geology. It includes an introduction to the methods made use of in the investigation of the optical and other physical properties of minerals, discusses the theory of polarized light, explains what is meant by "optical axes," "bisectrices," double refraction, etc., describes the polarizing microscope and other instruments used in the examination of minerals, and gives the principal characteristics of those minerals which enter into the composition of rocks. The explanations of the phenomena presented by sections of minerals when observed in polarized light, are given

[1] Neues Jahrb. f. Min., etc., 1888, ii., p. 123.
[2] Ref. N. J. B., 1888, i., p. 206.
[3] Bull. Soc. Franc. de Min., xi., p. 64.
[4] Ib., xl., p. 61.
[5] Rock-Forming Minerals. By Frank Rutley. With 126 ills. and 252 pp Thos. Murby, 3 Ludgate Circus Buildings, London, 1888.

with great clearness, with the aid of good figures, most of which are new. The second part, which deals with the properties of the individual minerals, is not as full as is Mr. Idding's translation of Rosenbusch's manual, but is entirely sufficient for all the purposes of students. Although a most excellent text-book for colleges, Mr. Rutley's work is hardly full enough in its special part for those who desire to make a specialty of petrography as an important aid in geological work. For those who wish merely to become acquainted with the methods of the science, there is no better book in any language.

"DAS MINERALREICH,"[1] the fifth volume of Lenze's Natural History Series, has been revised and brought up to date. In its present shape it is a handy little volume of five hundred and forty-four pages. It treats of the universal and special properties of minerals in a manner adapted to the wants of general readers and others, who are desirous of becoming acquainted with these substances, but who are unwilling to enter into their technical study. In the special part a large amount of space is devoted to those properties of the various minerals which make them suitable for economic use. As a consequence this portion of the book is much more interesting than the corresponding part in most text-books. In general style "Das Mineralreich" reminds one of Quenstedt's Mineralogie.

CROSBY'S "TABLES FOR THE DETERMINATION[2] OF COMMON MINERALS," has a great advantage over all other similar tables in common use, in that it deals only with those minerals with which the student is likely to meet in his every-day work. The determinative methods are based upon the physical properties rather than upon the blowpipe characteristics of the individual species. The tabulation is carefully done, and the little book will surely be welcome in those schools which are not provided with complete sets of blowpipe apparatus.

[1] Das Mineralreich. Bearbeitet von Dr. Otto Wünsche. V. Auf. Gotha, Thieanmanns Hofbuchhandlung, 1887. 544 pp., 16 Taf.

[2] Second Edition. By W. O. Crosby. Boston, 1888.

BOTANY.[1]

"FORTUITOUS VARIATIONS IN EUPATORIUM" is the title of a paper recently read by Lester F. Ward before the Biological Society of Washington. This was an interesting and suggestive talk without being a set paper. and led to many remarks by members present. Several definitions of life have been given, but Prof. Ward considered the best to be "a general tendency on the part of living matter to multiply itself, to increase its quantity." This increase may take place in all directions, and often does take place in more than one. If it is not in all directions it i because of obstacles in the way, and the real increase is in the direction of least resistance. Many variations are noticeable in both plant and animal world, that are apparently of no special advantage to the organism. These chance or fortuitous variations can scarcely have been produced by natural selection, inasmuch as there is no appreciable or even imaginable value in them to the plant or animal. There are, to be sure, many which are of advantage, and these are acted upon and improved through natural selection. Darwin has said, though with many reservations, that only advantageous variations are selected and preserved. This does not seem to be at all universally the case. Quantity not quality is the end for which nature strives, and this may be considered an almost universal law. Perfection in structure is a secondary consideration, while increase of quantity is of primary importance. Prof. Ward did not believe all variations were of use to plants. The general tendency to vary in every direction is often counterbalanced by a determined progress in one direction, and this is generally useful. The specimens of Eupatorium were so arranged as to show the variations in the leaves, these being more prominent than in the flowers. The leaves varied from finely dissected to linear, then to lanceolate and ovate. One hybrid with intermediate leaves was shown. There are about four hundred species in the genus. most of them South American, one Australian, and about thirty North American. The fact of great variation in the plants was undoubted. The fact of these being all beneficial is not proved. How a sharp or an obtuse point, a serrate or a crenate margin to a leaf would be of any benefit to a plant in any situation he could not see. Therefore it seemed to him that many of these variations should be considered fortuitous or chance variations due to the general tendency of all life to increase in all directions and so adding to the total quantity of life in the world.

Dr. Merriam rather dissented from the views of Prof. Ward, he believing the variations to be generally of some slight advantage,

[1] Edited by Charles E. Bessey, Lincoln, Neb.

though to us it may be inappreciable. Dr. Goode mentioned analogous variation in fishes, especially in the number of scales, the real usefulness of a greater or less number of these being unknown. Some families (as the Cyprinidææ) are remarkable for these variations, while others (*e.g.* Perches) are noted for few or no variations, the species being very distinct in all their characters. Prof. Riley fully agreed with Prof. Ward. His studies of insects showed the existence of many variations which were undoubtedly useful, but at the same time many others the purpose of which was not in the least apparent.—*Jos. F. James.*

ASTER SHORTII.—Mr. E. S. Burgess has noted the occurrence of *Aster shortii* in the vicinity of Washington, D. C., a plant which had not been previously recorded. Prof. Ward in this connection mentioned he had found a species of *Lemna* new to the flora, and Dr. Vasey said he had found a species of *Festuca* not before known from the locality.—*Jos. F. James.*

"CAUSES OF CONFIGURATION OF TREES."—Prof. Fernow, Chief of Division of Forestry, read a paper upon this subject. He exhibited several photographs of trees growing upon the sides of hills. The trunks of these formed nearly a right angle with the slope, and the branches were parallel with the slope. It was suggested by Prof. Ward that possibly the photographs represented an abnormal mode of growth, and that they were due to unusual conditions. It was also suggested that the peculiar direction of growth of branches was due to the cropping of cattle. Few of those present had ever seen trees similar to these, and most were inclined to the opinion that they represented something abnormal.—*Jos. F. James.*

THE NEED OF MAKING MEASUREMENTS IN MICROSCOPICAL WORK.—It is greatly to be desired that all workers with the microscope should make much more general use of the micrometer than is now the custom, particularly in botany. It is still a common thing to find descriptions of tissues accompanied by plates or figures with little to guide the reader as to the absolute size of the objects. In this the fathers sinned more than we, but we are by no means sinless, as may be seen by taking up almost any descriptive paper on botany. Cells, cell masses, filaments, hyphæ, spores of all kinds, pollen cells, etc., etc., should all be subjected to careful measurement. We may say that so many measurements are needless, but so the older botanists thought, greatly to our present discomfort.

In our botanical laboratories the student should be not only taught to make measurements of everything he studies, but the making of such measurements should be *a part of the study* of the object. No laboratory microscope should be used which does not have as one of its accessories always at hand an efficient micrometer.

Such a micrometer need not cost much. A simple disk of ruled glass dropped upon the diaphragm of the eye-piece will answer

every purpose in ordinary work. Or it may be a slip of glass which may be pushed through a slot in the eye-piece. Neither one ought to cost more than from one to two dollars, and ought to be afforded for every microscope in use in the laboratory.—*Charles E. Bessey.*

THE QUESTIONS OF NOMENCLATURE.—For some months a lively discussion has been going on in this country and England upon a few questions as to the proper interpretation of the laws relating to botanical nomenclature, the discussion in some cases broadening out so as to take in the inquiry as to the validity of certain laws, and the expediency of enacting new ones. "Shall we rigidly enforce the law of priority?" is the question which is causing the greatest disquiet just now. On the one hand we have those who urge its rigid enforcement, while on the other are those who say with Prof. Babington, "I think that we are going too far in enforcing the rule of priority in nomenclature as it is now attempted." (*Jour. Bot.*, Dec., 1888.)

Then there is the question as to the citation of the authority in case of a removal of a species from one genus to another. Shall we cite Linnæus still in case we remove one of his species into a genus which he may not even have known? If we do, we make him (say those of one party) say what he never said, while to cite as the authority the name of the author of the combination makes us lose sight of Linnæus as the originator of the specific name and the describer of the species. Upon this we merely inquire now whether we are to consider primarily the men who *have worked* in systematic botany, or the men who are working now and who will work after we are gone. Is all this matter of the citation of authorities for the purpose of "doing justice" to men, or for conducing to scientific accuracy? Do botanists think more of the "glory" of the individual, or the advancement of the science? We shall return to this erelong.—*Charles E. Bessey.*

BOTANY IN ST. LOUIS.—The recent reception of a volume of the Transactions of the Academy of Science of St. Louis (Vol. V., Nos. 1 and 2) reminds us of the work in botany which is being done in this Western city. Of the thirteen papers published, five are botanical, as follows: A Revision of the North American Linaceæ, by William Trelease; Description of *Lycoperdon missouriense*, by William Trelease: On the Pollination of *Phlomis tuberosa* L. and the Perforation of Flowers, by L. H. Pammel; Measurements of the Trimorphic Flowers of *Oxalis suksdorfii*, by W. G. Eliott, Jr.; Observations suggested by the preceding paper, by William Trelease.

In the first-mentioned paper twenty-one species of Linum are recognized as natives of North America. They are grouped under three tribes, viz.: (1) Eulinum, which includes *L. lewisii* Pursh (= *L. perenne* Auct). (2) Linastrum, including *L floridanum* Trelease (L. *virginianum*, var. *Floridanum* Planch). *L. virginianum* L., *L. striatum*, Walt., *L. neo-mexicanum* Greene, *L. kingii* Watson,

L. sulcatum Riddell, *L. rupestre* Engelm., *L. aristatum* Engelm., *L. rigidum* Pursh, and var. *puberulum* Engelm., *L. berlandieri* Hook., *L. multicaule* Hook. (3) Hesperolinon, including *L. digynum* Gray, *L. drymarioides* Curran, *L. adenophyllum* Gray, *L. breweri* Gray, *L. clevelandi* Greene, *L. micranthum* Gray, *L. spergulinum* Gray, *L. californicum* Benth., and var *L. confertum* Gray, *L. congestum* Gray. Two good plates illustrate the fruits, petals, and filaments.

The new Lycoperdon (*L. missouriense*) is 3 to 4 inches high and 2 to 4 inches in diameter, narrow below and enlarged and rounded above (*i.e.*, somewhat pear-shaped). Color of interior buff, spores globose, smooth, yellow $2\frac{1}{2}$–$3\frac{3}{4}$ μ in diameter. It grows in sod under trees.

Mr. Pammel's paper is a valuable one, but too long for a synopsis here, as are also the two remaining ones.

Arbor Day Literature.—This annual tree planting day, which has spread from the place of its origin on the Nebraska plains eastward to many of the States, has given rise to a number of books, the latest of which is the neatly bound and printed volume, "Arbor Day," by R. W. Furnas. It makes no pretence to profundity, nor poetry, but gives in sketchy way the history of the tree planting movement in the West, with appeals for the growth of trees for beauty and for profit, and includes lists of those most valuable for various regions, with practical suggestions as to methods. The book is dedicated to and contains a fine portrait of the "author of Arbor Day." Mr. J. Sterling Morton, of Nebraska. It is a pretty and pleasant contribution to the literature of a part of botany too often neglected or ignored by botanists.

Another School Botany.—Verily in botany "of making many books there is no end," and if one were obliged to study some of them he might well say with the wise man of old, "Much study is a weariness of the flesh." The last work to claim attention is one with the ambitious title of "Botany for Academies and Colleges, consisting of Plant Development and Structure from Seaweed to Clematis," by Annie Chambers-Ketchum, and brought out by the house of J. B. Lippincott Company, of Philadelphia.

The book is a book of definitions, and often not good ones at that. In the first paragraph we read that "Natural Science treats of all things in nature. Nature is a synonym for the Universe," and paragraph 5, "The plant is the vital link between the mineral and the animal. Plants feed on minerals and digest them into organic food." The style is sometimes rather lively, as, for example, in a note on zoospores (p. 7), "These little creatures are very social; they dance among themselves, circling merrily, but never jostling; no human dancers could be more polite; then when the heyday of youth is over, they withdraw their ciliæ (*sic*), produce an outer wall, send out root-like projections, and develop into staid mother plants"!!

In her attempt to make matters plain the author uses some odd terms, as "Virgin-parentage," "The Man's House," "The Woman's House," etc.

The second part of the book consists of a manual which is said to include "All the known orders with their representative genera." In this the Algæ constitute the first order, the Fungi the second, and the Lichens the third!

Without question the book cost the author a great deal of hard work, and it is a pity that it has been such a waste of energy.—*Charles E. Bessey.*

A VALUABLE BOOK FOR THE HERBARIUM.—Indispensable as Bentham and Hooker's *Genera Plantarum* is in the herbarium, it is often a troublesome book to handle on account of its great size. When one is obliged to search through the three volumes for some obscure genus the time taken is so much lost from work, and the wear and tear of the book itself from so much use is such as to threaten its early destruction. This is especially the case in those herbaria where advanced students have free access to the books and specimens.

The recently issued *Index Generum Phanerogamorum* by Th. Durand, of Brussels, is intended to take the place of the Genera Plantarum for much of the work in the herbarium. The orders and genera have the same sequence as in Bentham and Hooker's work. The mode of treatment may be made out from the following, taken from page 1:

ORDO I. RANUNCULACEÆ.

TRIBUS I. CLEMATIDEÆ.

1. **Clematis** L. G. I. 3 et 953.—Sp. descript. ultra 200, a cl. Kunze ad 66 reduct. Orbis. fere tot. reg. temp. et trop.
   Sect. 1. **Viticella** DC., Viticella Mörch.
   Sect. 2. **Cheiropsis** DC., Atragene L., Cheiropsis et Viorna Spach.
   Sect. 3. **Flammula** DC., Meclatic Spach.
2. **Naravelia** DC. G. I. 4.—Sp. 2 v. 3, Asia trop.

The first column of figures consists of a running enumeration of the genera which extends throughout the volume, the second column enumerates the genera of the orders merely.

In the prefatory conspectus the following table is given, showing the number of species (estimated) for the Phanerogams:

		Ordines.	Genera.	Species.
Dicotyledones	Polypetalæ	90	3,050	28,300
	Gamopetalæ	46	2,885	37,800
	Monochlamydeæ	36	849	12,100
		172	6,784	78,200
Monocotyledones		35	1,587	19,600
Gymnospermæ		3	46	2,420
Summa		210	8,417	100,220

The book is published in Berlin by the brothers Borntraeger, at about 20 marks.—*Charles E. Bessey.*

BACTERIOLOGY.[1]

A New Atlas of Bacteriology.—An important announcement is just received of a new photomicrographic "*Atlas der Bacterienkunde,*" shortly to be issued by Doctors Fraenkel and Pfeiffer, of the University of Berlin. The names of the authors and their connection with Koch's laboratory make it probable that the undertaking will be of great service and will supply to working bacteriologists a convenient standard of reference. The plan which will be followed in issuing the "Atlas" is, to give "a systematic representation of the most important bacteriological objects." Accordingly, there will be given "first, the bacteria in general, in the various stages of their life history, and, then, in particular, the microörganisms of the principal infectious diseases of men and the lower animals."

The figures will be accompanied by an explanatory text; and extreme care is promised to secure unusual mechanical excellence. The "Atlas" will appear in from 12–15 parts, each containing about 10 photographs. The first is promised in January, 1889, and the others at intervals of about six weeks. The number of copies is to be limited, and the cost, per part, is to be 4 marks. The "Atlas" may be had of Hirschwald, in Berlin.

The Bacteriology of Natural and of Artificial Ice.—One of the latest numbers of the *Centralblatt für Bakteriologie* (IV., 22, 673) contains a summary of a recent paper by Heyroth, in which the latter gives the results of some three years of investigation of the purity of ice, and brings the subject, so far as it has been pursued by himself and others, up to 1888.

The usual "plate" cultures were employed, and the conclusions finally arrived at are :

1. Water on freezing into ice always excretes from itself, so to speak, a portion of its chemical and organic contents.
2. Certain organic substances are less affected than are inorganic salts.
3. Above all, the microörganisms, and among these not merely the ordinary harmless water bacteria, but also disease-producing forms, are able to withstand the process of freezing as it occurs in nature, and even a protracted exposure to the frozen condition, without loss of vegetative capacity or enfeeblement of their virulence.

The investigations of artificial ice did not make for it as favorable a showing—or, at least, not in all cases. It appears that the water

[1] This Department is edited by Prof. Wm. T. Sedgwick, of the Mass. Institute of Technology, Boston, Mass., to whom brief communications, books for review, etc., should be sent.

employed is not always as unobjectionable as ordinary drinking water, and also that the water employed is sometimes rendered more or less impure by the careless use of the process it undergoes. Accordingly, figures as high as 528, 960, 1323, and even 1610 bacteria per cc. were found, although, on the other hand, specimens were found which were absolutely sterile.

The following conclusions were reached, viz.:

1. That the ice used for preservative purposes and for the cooling of drinks ought, no matter how prepared, to be made of such water only as has already been found to be pure, and at least as good as that adapted for a public water supply.

2. For the sake of the continuous protection of its composition periodical and repeated examinations should be made of the ice supply and its sources.

Dissection of the Dog as a Basis for the Study of Physiology.—A handsome and conveniently arranged guide to so much of anatomy as may be learned from a fairly thorough dissection of the dog has been prepared by W. H. Howell, of Johns Hopkins University, and published by Henry Holt & Co., of New York. The work is avowedly done by a physiologist for physiological purposes; and in our opinion it has been done wisely and with discrimination. The worker who is endeavoring to get broad ideas of the position and relation of organs and parts as mechanisms, should never be buried under anatomical minutiæ to him of secondary importance, or confused beforehand by being told minutely what to do, or worse yet, what to see. By giving undue attention to his guide he is distracted from the objects before him, and sooner or later is in danger of losing both the interest and pleasure of discovery and, above all, the final reward of increased power and independence.

The book is not too large, possesses the great merits of simplicity and brevity, and ought to prove a real help to classes of a certain grade, in physiology.—*W. T. Sedgwick.*

ZOOLOGY.

The Anatomy of Protopterus.—Prof. W. N. Parker communicates to *Nature* (XXXIX., pp. 19–21) a preliminary note on the anatomy and physiology of *Protopterus annectans,* of which abundant material has recently been received at Freiburg. The whole epidermis is packed with goblet cells, and besides contains here and there multicellular glands like those of Amphibia. The normal epidermal cells are covered with a cuticular cap. The muscles of the

body serve as a food supply during the period of hibernation, their substance being carried away by leucocytes. The account of the nervous system is reserved for a later paper, but the fact is mentioned that the pulmonary nerves cross at the base of the lungs. A sympathetic system was not found. The body is well supplied with epidermal sense organs except on the paired fins. The author has no suggestion to make concerning the rich nerve supply of these latter organs. The olfactory organ partakes of the character of that in both Fishes and Amphibia, having the accessory cavities of the latter and the epithelium of the former. The eye has a large lens, the choroid is rudimentary and pigmentless, and iris and pupil are absent. No sense-cells were seen in sections of the tongue. A curious tube-like epithelial organ opens on the floor of the mouth in front of the tongue. Except the large liver no glands were connected with stomach or intestine, digestion being largely performed by the instrumentality of leucocytes. Parker cannot verify Ayres' supposition that the lymphatics connect directly with the lumen of the stomach. The so-called urinary bladder is a cloacal cæcum, having much the position of the rectal gland of Elasmobranchs, and probably has no homology with the urinary bladder of other forms. The corpuscles of the blood are large, and the white are very abundant. The red corpuscles are oval and measure from .040 to .046 mm. in length and from .025 to .027 mm. in breadth. Of the white corpuscles two kinds may be distinguished: (1) large leucocytes of the ordinary form, and (2) leucocytes of various sizes, which, besides the ordinary pseudopodia, form stiff filamentous processes. Experiments render it probable that the latter convey nutriment from the alimentary canal to the blood and there disintegrate. Hyrtl's description of the circulatory apparatus of Lepidosiren would answer almost equally well for Protopterus There are no nephrostomes in connection with the kidneys. In a male with immature spermatozoa the anterior parts of the Müllerian ducts were present, each with an abdominal opening like that of the oviduct. In sexually mature individuals all traces of the Müllerian ducts disappear. The spermatozoa are carrot-shaped and are provided with two long cilia. The head of the spermatozoan was about .04 mm. in length.

Another Specimen of Hyla Andersonii.—On June 1, 1888, I found a single specimen of *Hyla andersonii* Baird in a wet place on the border of a pine barren, at May's Landing, N. J. It was quite lively when caught, but it soon became sluggish in confinement. Its voice was shrill and light, comparatively speaking ; and it consisted of a repetition of the same note three or four times in regular succession, in a sort of "peep, peep, peep, peep," as nearly as I can give it. The specimen was sent alive to Dr. C. C. Abbott, of Trenton, N. J., who says, in his "Catalogue of the Vertebrate Animals of New Jersey" (*Geology of N. J.*, Cook, 1868, p. 805) that it is "a Southern species, a single specimen of which was found in Camden Co. in 1863" by Dr. J. Leidy.

Jordan's "Manual of the Vertebrates," 5th ed., says "N. J. to S. C. rare," which statement is still further confirmed by my discovery as given above.

The specimen is still alive, and may be seen by applying to George Pine, Esq., Trenton, N. J.—*John E. Peters, Sc. Doc., May's Landing, N. J.*

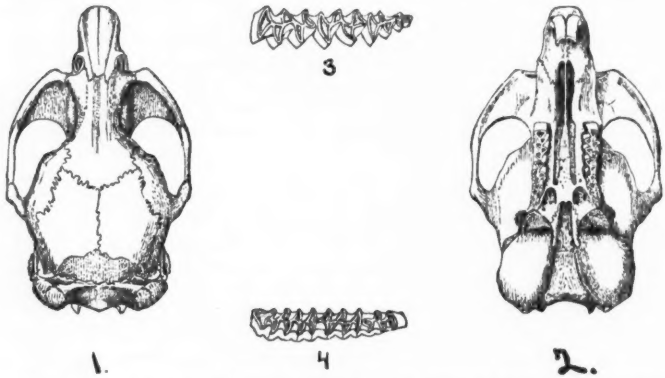
A NEW SPERMOPHILUS.—Dr. Merriam has recently described a new species of ground-squirrel from the Sierra Nevadas of California. He calls it *Spermophilus beldingi.* The characters are taken from the coloration and from certain peculiar features of the skull. A broad band of rufous brown runs down the back of the new species, while in the one nearest allied to it the whole back is covered with small spots, giving it a peculiar maculated appearance. The difference in coloration of the two is not due to seasonal changes, as suites of the two species were collected at the same period of the year.—*Jos. F. James.*

THE DEER OF CENTRAL AMERICA have been recently investigated by Mr. F. W. True. All the species are small, even the Virginia deer, which extends that far south. The Mexican deer seems to pass into the Virginian form. All the species are very much mixed up, and few characters seem to be constant enough to certainly characterize the species. The antlers. which have been largely depended upon, he did not consider reliable. A new species was described from the material in the National Museum.—*Jos. F. James.*

AN INTERESTING MAMMAL.—In the last number of the AMERICAN NATURALIST was noticed the discovery of a new Australian mammal. The *Zoologischer Anzeiger* for November 19, 1888, contains a short account by A. Zietz. from which we condense the following additional details. In form and size it resembles Chrysochloris. has a thick, short. fine whitish-yellow pelt. a small head with rounded snout, which is covered above by two horny plates, one behind the other. The skin is not perforated for the eyes, and the eyes themselves are only two black-pigmented points. The ear openings are covered by the fur; the nostrils lateral and slit-like. The salivary glands are very large. The fore feet are short, stout, and directed outwards, and the hands are folded longitudinally, bringing the fingers into two series, one of which is composed of the short digit 1 and digits 2 and 3 with long pointed nails. The other (outer) series consists of the 4th digit. with a small elongate, and digit 5, with a large triangular shield-like nail. The soles of the hinder feet are directed outwards; the toes, which are connected by skin, are armed with broad claws. The long, strong tail is hairless, but has strong transverse ridges and ends in a button. On the belly there is a well-marked pouch, 3 mm. long and 2 mm. (? cm.) wide. No external genital openings were seen. The dentition is

very peculiar and appears related to that of Amphitherium of the English Oölite. A clavicle is present. Only a single specimen is known, and that lacks the viscera and is partially decayed. It was found in the sandy region 500 miles north of Adelaide and 150 west from Charlotte Waters. The natives were questioned about it, and only one old woman could recall having seen one before. It appears to be a burrowing animal, and a portion of the alimentary tract which was preserved was filled with the remains of ants. It also appears to be a monotreme, and if the dentition can be relied upon, it forms an interesting remnant of the ancient fauna, and is to-day the oldest living mammal.

A CORRECTION: ARVICOLA (CHILOTUS) PALLIDUS.—The August number of the AMERICAN NATURALIST contains a description of the above-named species (Vol. XXII., 1888, pp. 702–705). Through a most unfortunate blunder, the illustration accompanying this description (p. 704), instead of being the drawing sent with the manuscript, is a figure of *Arvicola* (*Pedomys*) *minor*, which was published with a description of that species in the preceding number of



No. 4431. Female *Arvicola* (*Chilotus*) *pallidus* Merriam. From Ft. Buford, Dakota (Type) 1 and 2, skull, double natural size; 3, upper molar series, × 5; 4, lower molar series, × 5.

the NATURALIST (July, 1888, p. 599), the same cut being made to illustrate two very distinct subgenera! The accompanying figure is that of *Arvicola* (*Chilotus*) *pallidus*, and should be substituted for that on p. 704 of the August number. In the lettering under the skull of *Arvicola* (*Pedomys*) *minor*, p. 599, the skull number is given as 2245. It should be 2224. C. HART MERRIAM.

ZOOLOGICAL NEWS.—GENERAL.—Prof. J. B. Steere says (*Nature*, XXXIX., p. 37) that the Philippine Islands are readily divisible into several distinct sub-provinces clearly distinguishable by their faunæ.

These are (1) Northern Philippines, consisting of Luzon and Murinduque and a few small islands around Luzon; (2) Mindoro; (3) Central Philippines, embracing Panay, Negros, Guimaras, Zebu, Bohol, and Masbate; (4) Eastern Philippines, comprising Samar and Leyte; (5) Southern Philippines, made up of Mindanao, Basilau, and perhaps Sulu; and (6) Western Philippines, consisting of Palawan and Balabac.

ECHINODERMS.—Prof. P. Herbert Carpenter is studying the Comatulæ of the "Blake" explorations in the Caribbean Sea.

WORMS.—F. E. Beddard (*Nature*, XXXIX., p. 15) describes some very large hooked bristles upon the caudal end of an earthworm (? Urochæta) received from Bermuda which he suggests are correlated with the habit which most earthworms have of lying with the anterior part of the body out of the ground, only the tail being kept within the hole. These bristles would thus form very efficient anchors.

FISHES.—At a meeting of the Biological Society of Washington, Dec. 1, 1888, Dr. Gill made some remarks on the Psychrolutidæ, a small family of fishes established by Dr. Günther on a specimen found in the Gulf of Georgia. Later, another species found in New Zealand was referred to the same family, and a third was recorded from Patagonia. There seems little reason for making a new family for these three species. They probably belong to a section of the Cottidæ. The occurrence of species in New Zealand and in South America is interesting, inasmuch as it shows representatives of the Cottidæ exist in the Southern as well as in the Northern hemisphere.—*Jos. F. James.*

ENTOMOLOGY.[1]

ON PREVENTING THE RAVAGES OF WIRE-WORMS.—In a recently published paper,[2] the editor of this department makes a preliminary report on an investigation of wire-worms, now in progress. In the course of this investigation a method of combating these pests has been devised which promises to be of considerable importance.

At the beginning of our study of wire-worms, experiments were tried to ascertain if it were practicable to protect the seed and young

[1] This Department is edited by Prof J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Bull. Cornell Univ. Agr'l Exp. Station, iii., pp. 31–39.

plants in a corn-field by furnishing the worms with other food. Baits of sliced potatoes, clover, corn-meal dough, and corn-meal dough sweetened with sugar, were placed in various positions in a badly infested field. This was soon after the field had been planted and before the corn came up. In most cases the baits were placed on the surface of the ground and covered with small boards. Boards were used instead of earth for covering the baits to facilitate the examination of them. It now seems probable that more worms would have been attracted had the baits been buried.

The results of our efforts to trap wire-worms were very different from what we had expected. A few were taken in traps baited with sweetened dough, not enough, however, to be of much practical importance. But to our surprise, large numbers of click-beetles were taken. This at once opened a new line of investigation. If it is possible to trap and destroy the beetles before they have laid their eggs, we have at our command a much more effectual method of preventing the ravages of wire-worms than by destroying the larvæ after they are partially grown.

As indicating the possible efficiency of this method, I will cite a single instance. A series of twelve traps, which had been left undisturbed for only three days, yielded 482 beetles, or an average of more than 40 beetles per trap. And this notwithstanding that a considerable number had been attracted to other traps in the immediate vicinity.[1]

Of the substances used as baits clover attracted by far the larger number of beetles. The clover baits were small bunches about one-quarter pound in weight, of freshly cut stalks and leaves. Next to clover in the order of efficiency was sweetened dough. This was made by mixing one part sugar with ten parts corn-meal and sufficient water to make a dough. About one-half a teacupful was used in each trap. Unsweetened dough and sliced potatoes proved to be of nearly equal value, but much less attractive than sweetened dough.

We thus demonstrated that it is an easy matter to trap click-beetles in the places where they abound—that they will collect in large numbers upon baits of clover or of sweetened corn-meal dough. The collection of the beetles, however, from such baits involves considerable labor. We therefore conducted experiments to ascertain if this labor could be saved, and obtained the following results:

Many beetles were collected from our traps and placed in breeding cages. Some of these cages were supplied with clover, others with sliced potatoes, others with dough, and still others with sweetened dough. In one series of cages these substances were poisoned. In another, used as a check, the food was not poisoned. At the same time an extensive series of traps were placed in the corn-field. In this case alternate traps were poisoned, the others not.

[1] More than one-half of the click-beetles collected in these experiments were *Agriotes mancus*. Next in abundance was *Drasterius dorsalis*. A few specimens of *Agriotes pubescens* were also taken.

As was to be expected, no dead beetles were found in the traps that were not poisoned ; nor did the beetles die soon in those cages supplied with unpoisoned food. But where the clover or dough was poisoned the beetles in most cases were destroyed, proving that they feed upon these substances, and suggesting a practical method of combating them.

Although these experiments were conducted in a field from which a large number of the beetles had been removed, twelve examinations of the traps baited as described above yielded an average of 23½ dead beetles per trap. In some cases twice that number were found at one time in a single trap.

When we take into consideration the small amount of labor involved in distributing poisoned baits as described, and in renewing them once or twice per week during the early part of the summer, and consider also the large number of beetles that can be destroyed, many of them doubtless before they have laid their eggs, we feel warranted in earnestly recommending that these important pests be fought in this way.—*J. H. Comstock.*

NOTE ON CHINCH BUG DISEASES.—Two diseases of *Blissus leucopterus*, apparently efficient in suppressing an outbreak of this species in 1882, were described by me in my report for that year as State Entomologist of Illinois (pp. 47–54) ; but neither of these has been distinctly recognized since, until the present season. Now, however, the chinch bugs of the southern part of Illinois are being very rapidly destroyed by both these diseases, and a third not hitherto recognized—the last (seen by me first in July, 1887) due to a Botrytis distinct from the species (*B. bassiana*) well known as the characteristic fungus of muscardine in the silkworm.

One of the two first mentioned is caused by an Entomophthora whose specific affinities I have not been able to learn.

The other is due to a microbe (the *Micrococcus insectorum* of Burrill [1]) principally developed in the alimentary canal, and especially in its cæcal appendages, which are often literally crammed with it from end to end. This disease somewhat resembles that known as *schlaffsucht* or *flacherie* in the literature of the silkworm. Its germ is freely cultivable both in beef broth and in solid gelatine media, by the processes usual in bacterial investigation.

Both the Entomophthora and the Botrytis finally imbed the insect in a white fungus—the efflorescence of a spore-bearing mycelium. The Botrytis has been much more abundant and destructive in Illinois than the Entomophthora, although seemingly less so at present than the bacterial form.

It now seems likely that these diseases, occurring as they do

[1] American Naturalist, xvii., p. 319. This microbe, studied anew by Prof. Burrill from my recent cultures, solid and fluid, and from the affected chinch bugs themselves, proves to be a Bacillus of peculiar character, and not a Micrococcus.

spontaneously over a large area, will soon suppress what has probably been the longest continued destructive outbreak of the chinch bug known in the history of that insect. Their present activity is illustrated by the fact that in a single field in Southern Illinois dead chinch bugs imbedded in this mould were found by an assistant, Mr. John Marten, so numerous as to suggest a recent flurry of snow.—*S. A. Forbes* (in *Psyche*, Oct., 1888).

Poison of Hymenoptera.—One of the most interesting phenomena met by the student of the habits of insects, and one that has long excited wonder, is the fact that the Digger-wasps or Fossorial Hymenoptera sting the insects with which they provision their nests in such a way that the insects are paralyzed, but not killed.

It has been commonly believed that the Digger-wasps could easily destroy their victims if they chose to do so; but instead of doing so they sting them "just enough to paralyze them but not enough to kill them;" for they know instinctively that on the one hand dead insects would not be suitable food for their young, and on the other, that if the insects with which the nest is provisioned are left uninjured, the larva which hatches from the egg placed with them would be unable to overpower them.

Some have held that the paralyzing of the prey is accomplished by making a slight sting in one of the ganglia of the ventral nervous system. This, however, implies an instinctively obtained knowledge of insect anatomy which is to say the least remarkable.

A very different explanation of the phenomenon is now offered by M. G. Carlet.[1] In an earlier note[2] he showed that the wound inflicted by the Hymenoptera with a barbed sting (Bees and true Wasps) always resulted in a mixture of two liquids; one, an acid, the other, an alkali, each secreted by a special gland. And he also showed that the venom produced the usual results only when it contained these two constituents. He has now studied the poison of Hynenoptera with a smooth sting (Philanthus, Pompilus, etc.), and finds that with these the alkaline gland either does not exist or is rudimentary. These are the Hymenoptera whose incomplete poison does not kill the insects with which they provision their nests, for the purpose of feeding their larvæ with living prey. In M. Carlet's opinion it is the presence of the two liquids or of one only which produces respectively the mortal poison or the anæsthetic, and not the asserted power to select the point of the body at which the Digger-wasp will sting its victim.

Report of the State Entomologist of New York.—Dr. Lintner's Fourth Report has just appeared. It makes a volume of 237 pages, and includes accounts of a large number of insects, some of which are described here for the first time. This report, like those that have preceded it, is the result of a great amount of pains-

[1] Comptes Rendus, cvi. (1888), pp. 1737–40.
[2] Ib., seance du 23 juin 1884.

taking labor, and is a valuable addition to the literature of Economic Entomology. The number of subjects described is so large that it is impracticable to give an abstract of the report.

THALESSA AND TREMEX.—A paper was recently read by Prof. Riley, entitled "Notes on the Economy of *Thalessa* and *Tremex*." *Thalessa* is an Ichneumon fly having in some species an ovipositor six and seven inches in length. The eggs are laid in the burrow of the larva of *Tremex* and not in the larva itself, so it is an external and not an internal parasite of the larva. The ovipositor performs the part of a saw and drills a hole in the bark over the burrow of *Tremex*. Owing to the great length of the ovipositor, it was long a question how the insect could reach the bark to deposit its eggs. It is accomplished by the insect so manipulating the organ with its feet as to form a double coil in a special membrane between the last two segments of the abdomen, then curving it over and passing it downward so as to reach the wood. In the pupa this ovipositor is bent round and along the ventral surface and then backwards again along the dorsal surface.

A "HUMAN PARASITE."—Prof. Riley mentions in a general way the occurrence of parasites upon or in the human body. He mentioned particularly the case of a lady in Washington who felt herself stung by some insect. In the course of a few weeks she was annoyed by a pimple on her neck. When pressed, there was forced from the spot a small larva, of some species of bot-fly, but as nothing was known of its parent, its identification was impossible. Reference was also made to another parasite noticed by a physician of New Orleans, an account of which had been given in a late mumber of "Insect Life." —*Jos. F. James.*

EMBRYOLOGY.[1]

THE BYSSUS OF THE YOUNG OF THE COMMON CLAM (*Mya arenaria* L.).—During the past summer Mr. Vinal N. Edwards, the well-known collector of the U. S. Fish Commission, at Woods Holl, found young clams adhering in great numbers to the surface of floating timbers in the harbor of New Bedford, Mass. They were associated with Ascidians (*Molgula*) in this unusual position, and very naturally attracted the attention of so observant a field-naturalist as Mr. Edwards, who very kindly brought me an abundant supply of specimens. The masses as they came into my hand were in flakes formed of marine algæ and earthy matters, sand, and mould, which

[1] This Department is edited by Prof. John A. Ryder, University of Pennsylvania, Philadelphia.

had been peeled off of the surface of the floating timbers. These masses were traversed superficially by a mat of fibres which were found to be derived from the outer tunic or mantle of the Ascidians, by means of which the latter were adherent to their support.

At first, in separating the young clams from their singular place of support, it was supposed that their rather firm adhesion was altogether due to their having been caught during the very early veliger stage in this mat of fibres formed about the bases of the Ascidians. As they grew larger it was further supposed that they were held fast in their unusual position by the fibres and cement substance secreted by the mantles of their Ascidian neighbors, and thus were suffered to attain a considerable size (from two to fifteen millimetres) before they finally became free and sank into a more favorable position on the bottom. However, further investigation showed that in this I was in error, for after a careful search, a few individuals were found from which a single byssal thread was found to proceed, invariably from the point where the tip of the foot is thrust through the median opening in the mantle. To make it still more certain that there should be no mistake, the byssal thread was pulled out of its insertion in several specimens, when it was found to present the irregular swollen proximal end usually found to characterize the intraglandular portion of the byssus in molluscs which possess this organ. The subject at this point became sufficiently interesting to warrant farther study, and, inasmuch as but a few individuals were found which had the byssal thread in place, that structure being usually torn loose in removing the specimens from their support amongst the Ascidians, it became necessary to resort to the methods of sectioning to determine if there was a byssal gland present in the foot.

To this end a number of specimens were treated first with a dilute chromic acid solution (one-half per cent.). After this had fixed the tissues, the solution was renewed and acidulated with nitric acid (one-half per cent.), and allowed to act until all of the calcareous matter had been removed from the shell. This left the specimens in good histological condition for cutting, after which the specimens were washed, dehydrated, and saturated with celloidin, in which they were embedded and sectioned on a Schanze microtome.

The sections were cut parallel to the median longitudinal plane, or so as to coincide with the union of the edges of the mantle along the margins of the valves. Besides disclosing the unmistakable anatomical structure characteristic of *Mya*, there was found in the sections of the median region at the apex of the foot a median saccular depression which was undoubtedly the byssal gland with the thread in place or with remains of the secretion from which the byssal thread was formed.

This discovery leaves no doubt as to the fact that this well-known mollusc is provided with a byssus during its early life. One series of sections in my possession, from a specimen ten millimetres long, shows the structure admirably. How much longer than usual

the young clams were kept suspended in this instance on account of their accidental and supplementary adhesion to the Ascidians cannot be determined, but it is fair to suppose that their period of suspension would be prolonged on that account beyond the usual time.

The presence of a byssal attachment in *Mya arenaria* reopens the question of the life-history of this important shell-fish. In fact, it is probable that some of its allies may have an unknown byssal stage, and, perhaps. types somewhat distant from it in the system, but with similar habits in the adult condition, such as *Glycimeris* and *Panopæa,* may also have such a stage. In that case the methods hitherto proposed to be adopted in order to secure the young for purposes of transplanting would have to be greatly modified It is very probable that this arrangement is a protective one and that the suspension of the young of *Mya arenaria* is for the purpose of protection during the early and most precarious period of existence of the animal. To obtain the early stages of the young ti will accordingly be necessary to resort to some form of "collector" or cultch, such as is used in oyster-culture, to allow the fry to affix itself.

While there is a very sharply defined homogeneous larval shell or protoconch in the young oyster, this seems to be absent or not sharply defined in the young of *Mya arenaria* in specimens two to three millimeters long. In *Chlamydoconcha* the protoconch or larval shell is preserved even in individuals supposed to be adult, since here both valves are completely invested by the closed mantle sac, the shell being internal. The detection of a byssus in the young of *Mya* is of interest also from the fact that it suggests that such organs are probably present in the young stages of still other Lamellibranchs, where it has not been hitherto suspected.—*John A. Ryder.*

PHYSIOLOGY.[1]

ON THE RHYTHM OF THE MAMMALIAN HEART.—Prof. John A. McWilliam,[2] of the University of Aberdeen. extends to a study of the mammalian heart the methods of work which in the hands of Gaskell, Mills, himself, and others have led recently to such valuable results concerning the organ in Fishes, Amphibians, and Reptiles. He experiments with cats, dogs, rabbits, hedgehogs, guinea-pigs, and rats, partly on the excised heart and partly on the heart *in situ,* and obtains many interesting data, which he compares with the known facts in the cold-blooded animals. As in the latter, so in

[1] This Department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.
[2] The Journal of Physiology, Vol. 9, p. 167.

mammals the contractions of the heart muscle are always maximal, and a rhythmic rise and fall occur in the muscular excitability—a fall immediately succeeding the contraction, followed by a gradual rise during the phase of relaxation ; hence the more rapid the beat, the less powerful it is, and *vice versa*. Constant currents and weak induction currents are alike in causing an acceleration of beat in an already active heart, and the appearance of a rhythmic series of beats in one previously quiescent. As in all other Vertebrates, the mammalian heart-beat partakes of the nature of a progressive contraction beginning at the venous end of the organ. The place of origin of the contraction seems to be the walls of the great veins, and the time of origin is the same for the venæ cavæ and the pulmonary veins. Whether the mammalian cardiac rhythm is nervous or myogonic—*i.e.*, whether it is a property of nervous or muscular tissue—is impossible at present to decide. That heart muscle has a spontaneous rhythmic power of its own is abundantly proved for Fishes, Amphibians, and Reptiles, although it seems that normally, in the auricular muscle at least, such power is in abeyance. The following facts concerning the mammalian heart muscle will help in the future to elucidate this subject. All parts of the heart are endowed with independent rhythmic power, as is proved by the continuance of rhythmic contractions in parts separated from each other—*e.g.*, in ventricles separated from auricles ; the independent ventricular rhythm seems at times to be myogonic, for by increasing the local excitability, as by the local application of heat, the contraction may be made to begin in the apex, where, according to the researches of the author and those of Kasem Beck, nerve-cells do not occur ; the automatic rhythmic property is not equal in the various parts of the heart, being apparently highest in the venous terminations, and lowest in the ventricle, as indicated, among other things, by the slow rhythm in the isolated ventricle (which is in harmony with what exists in the lower Vertebrates) ; the rhythm originating at the venous terminations apparently dominates the whole heart, and determines the rate of its action ; hence the causes determining the rhythm of the intact heart are to be sought for at the venous end of the organ. The usual order of contraction may be altered and even entirely reversed by artificially stimulating a portion of the surface—*e.g.*, stimulation of the ventricle is followed by contraction of the ventricle, then auricle, then venous terminations.

The question of the mode of propagation of the normal contraction over the auricles and ventricles is discussed by the author at some length, in view of the fact that Gaskell has urged that in the tortoise the phenomenon is simply one of muscular conduction. Such an explanation is negatived at once for the mammalian heart, as regards the passage from auricle to ventricle at least, by the fact that here is a distinct break in the muscular continuity, the auricles and ventricles being separated by a considerable amount of connective tissue. It seems impossible to account for the sequence on

purely physical grounds, such as the distension of the ventricular cavities, the electric variation accompanying the auricular beat, or the sudden tension of the chordæ tendineæ resulting from the contraction of the auricular muscle fibres which go down into the auriculo-ventricular valves. The author is hence forced to a belief in the existence of a nervous mechanism for the propagation. What this mechanism is, is not known, but it is possible that an extensive nerve plexus exists throughout the whole of the cardiac wall. Passage of the contraction through the substance of the auricle is independent of the great nerve-trunks, since these may be destroyed and the wall even cut into zigzag strips without interfering with the action.

CONNECTIONS OF MEMBRANOUS LABYRINTH.—In Fishes, Amphibians, and Reptiles the *ductus endolymphaticus* of the inner ear has long been known not to constitute a closed cavity, but to join the exterior (Elasmobranchs) or the lymph-spaces of the cranial cavity. Rüdinger[1] finds an analogous arrangement to exist in mammals and man. The ductus does not here end blindly, as has hitherto been supposed, but by means of several branched canals is in communication with the subdural lymph-spaces of the dura mater. These canals are probably homologous with those of the lower vertebrates. The author regards the ductus as an elastic bag, the function of which is to enable the differences of pressure occurring within the labyrinth to be readily balanced. The size, the bladder like form, and the situation of the ductus in the cranial cavity, instead of within the bony labyrinth, favor such a theory.

FUNCTION OF THE COCHLEA.—The most commonly accepted hypothesis regarding the mode of analysis of composite sounds by the cochlea is that of Hensen, according to which a small portion of the basilar membrane is put into vibration by the incoming waves; deep tones affect the membrane where it is widest—*i.e.*, at the apex of the cochlea; high tones affect the narrow portion at the cochlear base. This theory is supported by an observation of Munk that a dog, in whom the base of the cochlea had been injured, could hear low tones only. Stepanow[2] has recently tested the theory experimentally by destroying the apex of the cochlea in the guinea-pig, in which animal the cochlea projects freely into the auditory bulla. Different instruments, comprising the violin, piano, harmonica, Galton's whistle, B-bass, tuning-fork, etc., were employed to test the power of hearing; and the perception of sound was inferred from the reflex movement of the ears. In spite of destruction of a considerable portion of the apical region of the cochlea, accompanied by loss of endolymph, the animals reacted to all tones, and, what is especially

[1] Sitzungsber. d. math.-phys., Cl. d. k. bayer., Akad. d. Wiss., 1887. Heft. 3, p. 455. Cf. Münchener Med. Wochenschr., 1888, p. 139.
[2] Monatschr. f. Ohrenh., xxii., p. 85. Cf. Centralblatt f. Physiologie, 1888, p. 298.

important, perception of the deep tones did not seem to be wanting. The author regards Hensen's hypothesis as not proved, and inclines to the theory of Voltolini that each nerve fibre of the cochlea recognizes all tones.

A Recent Study of "Rigor Mortis."—Some important work on rigor mortis has lately been done in the Physiological Institute at Königsberg by Max Bierfreund, cand. med.[1] Since the time of Nysten (1811) physiologists generally have suspected that the nervous system has some appreciable influence upon the time of appearance of rigor, and possibly upon its subsequent intensity. Munk, Bleuler and Lehmann, v. Eiselsberg, Tamassia, and others have investigated the question and have come to quite contradictory conclusions. Tamassia asserts that rigor is completely independent of the nervous system, and supports this theory by the results of a number of experiments on frogs, sparrows, and guinea-pigs. A. v. Gendre, v. Eiselsberg, and now Max Bierfreund have, on the other hand, arrived at the opposite conclusion. Bierfreund has found in all the experiments performed by him decided evidence that some influence proceeds from the nervous system. When he cut the sciatic nerve of a freshly-killed animal he found that rigor mortis always set in on that side 10–20 minutes later than in the muscles of the uninjured leg. This indicates that the nervous system exercises a quickening influence upon rigor, and this view is fully borne out by experiments upon the central nervous mechanism. Division of the lateral columns of the spinal cord or extirpation of one of the cerebral hemispheres will cause a delay in the appearance of rigor on the side which is dependent on the part removed. Bierfreund found, also, as might have been anticipated, that destruction of the central organs diminished the intensity of the rigor.

The red muscles stiffen much later than the white (11–15 hrs. as against 1–3 hrs.) ; and the time taken for completion of the rigor in the red muscles is much longer (52–58 hrs. as against 10–14 hrs.). Bierfreund sees in this fact an explanation of the so-called law of Nysten that the muscles of the body fall into rigor in a fixed and definite order. He observed, for example, that in rabbits the muscles of the hind limbs, where white muscles predominate, invariably stiffen sooner than those of the fore limbs, where the muscles are exclusively red.

High temperatures hasten the onset and the subsequent disappearance of rigor. Narcotics (chloroform and ether) if inhaled, delay it, but, if injected into the blood, produce a condition similar to rigor by their direct effect on the muscle substance. Chloral, which has no direct influence upon the muscle, effects a retardation of rigor when injected into the blood. Curare, according to von Eiselsberg and von Gendre, appears to destroy completely the influ-

[1] Untersuchungen über die Todtenstarre, Pflüger's Archiv, Bd. XLIII., S. 195.

ence of the nervous system. Stimulation of the sciatic on one side with a subminimal electric current causes rigor to appear later on that side.

The disappearance of rigor is not due to the fact that putrefaction liquefies a coagulated proteid. Putrefaction and rigor do not run parallel courses; frogs are occasionally found in a state of rigor in spite of intense putrefaction. If putrefaction be checked by injection of carbolic acid or corrosive sublimate into the blood-vessels of the animal the rigor disappears just as quickly as in an animal in which putrefaction is given full sway.

Bierfreund regards as highly significant the fact, that rigor vanishes of itself and independently of the putrefaction. He looks upon rigor mortis as the last contraction of the muscle, the last act in the life-history of the muscle fibre; but by what stimulus or stimuli this contraction is called forth, he leaves us still uncertain. —*E. D. Jordan, Boston.*

THE MECHANICAL ORIGIN OF THE HARD PARTS OF THE MAMMALIA.—A paper on this subject was read by the writer before the American Philosophical Society, Jan. 3.

Summarizing the investigation, the author stated that the structures of the mammalian skeleton and dentition may be referred broadly to the two general classes, excess of growth and defect of growth. Each of these may be again divided into two series as follows:

$$\text{Excess of growth}\begin{cases}\text{Use.}\\\text{Luxuriance.}\end{cases}$$

$$\text{Defect of growth}\begin{cases}\text{Disuse.}\\\text{Poverty.}\end{cases}$$

The paper dwelt principally with the first two conditions, which have frequently co-operated in the development of structures. These were classified under the following mechanical energies as causes:

A. Motion in articulation.

1. Impact only.
   - Facetting of distal end of radius in Diplarthra.
   - Expansion of proximal end of radius in Diplarthra,
   - Grooving of distal end of tibia by astragalus.
   - Grooving of proximal end of astragalus by tibia.
   - External trochlea of humerus in Rodentia (Leporidæ), and metapodials and humerus in Diplarthra.
2. Torsion only.
   - Alternation of carpal bones in Anthropomorpha.
   - Symmetrical flanges of ulnar cotylus in Anthropomorpha.
   - Unsymmetrical flanges of ulnar cotylus in other mammalia.
   - Rounding of head of radius in Edentata and Quadrumana.
   - Involution of eygapophyses in Diplarthra, etc.
3. Torsion and impact without flexure.
   - Alternation of carpal and torsal bones in Ungulata.

4. Torsion, impact, and flexure in one plane.
   Tongue and groove joints in many orders.
5. Flexure in two planes.
   Saddle-shaped cervical vertebræ in Quadrumana.
6. Flexure in several directions.
   Ball and socket vertebral articulation.
   Heads of humerus and femur.

AA. Motion not in articulation. (Teeth.)

7. Displacement of cusps of triconodont molars by crowding.
   Tritubercular molars.
8. Transverse thrust.
   The Vs of molars teeth in various orders.
9. Longitudinal thrust.
   The Vs of the Multituberculata.
   Obliquity of molars in many Rodentia.
10. Stimulation of pressure and strain.
    Incisors of Rodentia, Multituberculata, etc.
    Prismatic molars of Diplarthra, Rodentia, etc.
    Confluence of cusps into crests generally.
    Sectorial teeth of Carnivora.
    Canine teeth in general.
    Incisors of Proboscidia, Monodon, Halicore, etc.

As a general result we may assert that that it is a general law of animal as of other mechanics—viz., that *identical causes produce identical results*. The evidence for this law may be arranged under two heads, as follows :

I. The same structure appears in distinct phyla which are subjected to the same mechanical conditions. Examples of this are : the identical character of the articulation of the limbs in Diplarthra and Rodentia which possess powers of rapid locomotion. The identical structure of the head of the radius in Edentata and Quadrumana which possess the power of complete supination of the manus. Identical reduction of the number of the digits under increased use of the limbs in many of the orders. Identical modification of dental cusps into longitudinal Vs and crescents under transverse strains in several orders, and into transverse crescents under longitudinal strains, in the Multituberculata. Identical modifications of the form and development of crests of the skull under identical conditions of use of the canine teeth for defence, in all the orders where the latter are developed.

II. Different structures appear in different parts of the skeleton of the same individual animals in consequence of the different mechanical conditions to which these parts have been subjected. Examples: the diverse modification of the articulations of the limbs in consequence of difference of the uses to which they have been put, in mammals which excavate the earth with one pair of limbs only, as in the fossorial Edentata, Insectivora, and Rodentia. The reduction of the number of digits in the posterior limb only, when this is exclusively used for rapid progression, as in leaping ; this is seen

in the kangaroos and jerboas, in the orders Marsupialia and Rodentia.

There are a good many structures in the skeleton of the Mammalia which have not yet received a satisfactory explanation on the ground of mechanical necessity. Such, for instance, appears to me to be the condition of the history of the origin of the canine tooth; that is its use in preference to an incisor for raptorial purposes. Such may be also the history of the origin of the complex vertebral articulations of the American Edentata, as compared with the simple articulations of the Old World. In these, as in similar cases, however, an element enters which must be taken into account in seeking for explanations; that is, that every evolution is determined at its inception by the material or type from which it originates. Thus is explained the fact that identical uses have not produced identical structures in the limbs of all aquatic animals. The fin of the fish is essentially different from the paddle of the Ichthyosaurus or the whale. The beak of the rapatorial bird is different from the canine tooth of the rapacious mammal. When this principle is duly considered, many mechanical explanations will become clear, which now seem to be involved in difficulty or mystery.—*E. D. Cope.*

PSYCHOLOGY.

Grasshopper Reasoning.—I was on the railroad train from Newport, Vermillion County, for Terre Haute. A grasshopper in a heedless spring lit on the glass window of the coach. It was a warm, dry, dusty day of the drouthy summer. That little hopper looked through the glass and seemed astonished; the car was moving with increasing velocity, and thus surrounded by the current of air, the quiver and rattle of the car, seemed afraid to jump; and perhaps recalling the terrors of railroad accidents, was too cautious to fall off. So, calmly studying the situation, he decided to stay and ride to the next station.

On the polished surface of the giving, dusty glass, his feet became dry and his footing insecure. Mental resources came to his rescue. His memory and reason notified him that he must keep the suction cushions of his feet wet to insure an adhesive vacuum. So, after carefully planting his feet in safety, he carefully raised one foot to his mouth or lips and moistened it. It was a success, as reason and old memories and hopper philosophy had told him. Another and another foot was so moistened, and the hopper, armed with memory, prudence, and philosophic reason, rode on the train to the next sta-

tion, affording entertainment to several admiring friends. Hon. John Whitcomb, of Clinton, first called our attention to the cute little fellow.—*C., in Indiana Farmer.*

FROGS EATING SNAKES.—For several months I have kept in the house a sort of "zoological garden" in which there have been a few specimens of frogs, salamanders, and snakes. A few weeks ago I placed therein two full-grown leopard frogs and a hog-nosed viper about nine or ten inches in length. There were already in the box two garter-snakes two feet long and three salamanders—nothing else at that time. For a time everything went well, but about two weeks later the little viper was missing. A diligent search failed to find it, and careful examination of the cage showed no place of escape. The disappearance seemed quite mysterious, and the conclusion reached was that it had fallen a victim to cannibalism on the part of one of the other reptiles, although neither showed any signs of having feasted so extensively. Ten or fifteen days later a friend and I went to take a look at the pets. We found in the excrement of one of the frogs what on examination proved to be the skin, etc., of a snake, apparently the lost viper. When first found not more than half the length had passed, and the process was evidently causing the frog considerable effort. It was using its hind feet to assist in freeing itself.

Was the inference that the frog had swallowed the snake justifiable? I had never heard of such an occurrence; nor have I since been able to find any one who has. I was greatly surprised, for it seemed to me almost impossible. The swallowing of frogs by snakes I have several times seen, but I have never known the operation to be reversed, except in this instance.—*H. L. Roberts, Lewistown, Ill.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

THE AMERICAN HISTORICAL SOCIETY held its fifth annual meeting in the National Museum at Washington, D. C., beginning December 26, and continuing three days.

Among the many papers read, about the only one bearing upon Anthropology was that of Major Powell, introducing a "Language Map of North America." This map was displayed before the audience and the different Indian languages depicted thereon by different colors. An abstract of the Major's remarks and description is as follows:

[1] This Department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

"There is but one human species; but one human race. All differences are but variations of the one and original species. There were two great peoples of this one human species living on the two different hemispheres, unknown to each other. Columbus, voyaging from the one, discovered the other. and introduced them together. Further acquaintance developed the fact that even before his time there was a greater number of living languages in America than in Europe. If there was not more civilization, there was certainly more philosophy. We have failed to comprehend the extent to which this is true.

"Fifteen years ago I was called upon in my official capacity to classify the North American Indians. After various attempts and much consideration, I decided that the only practical or satisfactory classification was that to be made by language. Other persons had treated the subject in the light of zoology, and had attempted to classify man as an animal. Divers measurements of the crania were resorted to, anthropometry was put in active operation, tests were made of the color of the skin, hair, eyes. etc., but all such have failed as means of classification. We discovered as we progressed that classification by language was fundamental and wrought a classification in civilization, sociology, religion, mythology, art, etc.

"This map exhibits our conclusions so far as our work has been completed. It is intended to represent the condition and location of Indian tribes as manifested by their languages at the advent of the white man, though succeeding epochs have sometimes necessarily been shown.

"The Eskimos occupy the northern coast line like a fringe from Labrador to Alaska. They speak practically the same language. The Athabascan, occupying almost the entire territory of British North America, speak many languages, each distinct from the other, and yet belonging to the same stock and showing that they were the same people. We find this language scattered in spots through California and Old and New Mexico.

"The next group of languages, forty or fifty in number, scattered over the eastern and northeastern United States and Canada. was the Algonkin, and yet we find the Arapahoes down near the Gulf of Mexico to belong to the same stock. Likewise the Iroquois, variously called the Five or Six or Seven Nations, have a modern representative in the language of the Cherokees.

"The Siouan group had its habitat on the prairies between the Mississippi and Missouri. The Shoshonian group comprises twenty-five different languages. The Pueblo Indians employed four or five different stocks, but they all belong to the Shoshonian language.

"We have gathered material showing seventy-three different stocks of languages and nigh eight hundred dialects among the Indians of North America, and we have been aided in our work by the labors of missionaries, scholars, and of volunteers.

"Our work has made us more conservative. We now depend more

on evidence and less on theory. Our arrangement is based on the vocabulary—the roots of words. We have not depended upon the structure of their language. Structure means only different grades or degrees in development. A single language in its different dialects may exhibit at one and the same time both the highest and the lowest grade of structure or development. This is true of the Shoshônian. The language of some of the Indian tribes had a higher order of structure and a better grammar than had the English. The grammar of a language is born in barbarism.

"An attempt has been made in the present day, by a German, to construct a new language, and its inventor or maker has declared his purpose to take the good things of all languages and put them together for his new language. Suppose a zoologist should attempt to construct a new animal, or a new species, upon the same line, and. for instance, for the extremities of the body, he takes the hoofs of the horse, the wing of the bird, the fin of the fish, and the hand of man, and uses them all in the construction of his new animal because they all served a good purpose in the old. The result would be the same as in the new language, Volapük—the conglomerate monster of modern language."

We have seen the Linguistic Map of North America prepared by Major Powell and his assistants. It is a great work, worthy all commendation. The science had need for it, and it could scarcely ever have been done by private enterprise. It was fit and proper that it should be done under Government patronage, and all credit is due to the men who have made it.

In giving it this commendation, we do not at all assent to Major Powell's criticisms of other means of classification, and his laudation of language as the only correct or valuable one.

His may be, or may not be, the best system for the classification of the modern North American Indian tribes, but certainly is not for the real prehistoric races, whether of the Western or Eastern Hemispheres. However much we may theorize concerning their means of communicating ideas to each other, we are absolutely without knowledge as to the language they employed. But we make no dispute with Major Powell. This work done by him has enough of good in it to receive our approval, without wasting our strength in disputing over his criticism of other methods. The truth is, that all systems, all means, all methods, of determining the differences between the various Indian tribes, and, perhaps, between all races of men, are necessary and important in establishing the true classification. We may not pin our faith to one alone, but may use all, getting from each whatever of good it may furnish. The other method of classification will continue to be used, and Time, the great leveller, will set all things right. We can afford to wait.

APPROPRIATIONS BY CONGRESS FOR THE U. S. NATIONAL MUSEUM.—"England has become thoroughly aroused to the necessity

of encouraging science and art. Availing herself of the fifty thousand volumes and the hundreds of cases of natural history left by Hans Sloane, a native of Ireland, she founded the British Museum. Later in the century she spent half a million dollars on the National Gallery, and has annually bestowed upon it a liberal allowance. The South Kensington Museum, the National Portrait Gallery, and the India Museum are all of comparatively recent origin, and have cost the Treasury millions for their foundation and support. Museums of art have been opened in the provincial towns, supported in part by corporate, in part by private, and in part, indirectly, by Parliamentary aid. The effect of Kensington and other training-schools upon the industry of England has been such that last year a leading French authority cried out that if France did not bestir herself, England would take from her the markets of the world, which the superior technic and taste of the French designers have monopolized for a century, or since the establishment of art schools throughout France. Parliament expended last year upon the science and art of England nearly $5,000,000, and upon science and art in Ireland nearly $300,000."—*Margaret F. Sullivan, in December Century Magazine.*

If comparisons were not "odorous," one might be drawn between the policy and action of the United States Government and that of Great Britain as set forth in the foregoing extract.

The United States National Museum is the only institution supported by the United States Government which stands as a representative of the British institutions mentioned above, and on which its Government has spent millions.

The appropriations made by the United States Government for the National Museum are barely sufficient to keep it alive. They are provision for its daily running expenses, and barely adequate for that. What the museum, its contributors and correspondents, persons throughout the country interested in kindred scientific pursuits, and the public generally, have good right to complain of is that no provision is made in these appropriations for the purchase or securing of specimens, however great their value or importance, nor for the enlargement or increase of the collections. The Congress, it would seem, fails to comprehend the scope and purpose of the National Museum. It seems to consider it as a mere gathering of curiosities (maybe monstrosities) which may serve to amuse and interest for an afternoon a stray constituent who may have come in from the rural districts and seek attention at his Congressman's hands. The Congress at large seems not to know, or, if it does, ignores the fact that the National Museum is an extensive, and ought to be fully equipped, organization for the education of the people and for conducting investigations in science not possible to be done by private individuals.

In other countries it would be liberally supported and generously sustained. With a geographic area larger than combined Europe the United States treats its science, especially its science of archæology,

with less interest, or care or attention, if we measure these things by the appropriations made, than do the third-rate powers, such as Portugal, Denmark, Sweden, Switzerland, etc. Yet the area of the United States is as rich and as new, and will pay as largely for cultivation, as any like area in Europe. The States of Ohio, or Wisconsin, or West Virginia, or Mississippi, not to mention New York or New England, have either of them within their borders as much unstudied, unsearched, and unclassified archæologic riches as has any one of the great countries of Europe: England, France, Germany, Spain, or Italy. Yet these countries, each of them, do more for their archæology than equals the combined efforts of the United States and all the State governments.

I confess to a feeling of depression when, on visiting the Prehistoric Museum at Salisbury, England, I found there stored and displayed, in a beautiful building, erected in the midst of a lovely park, for its sole occupancy, the prehistoric collection of Squier and Davis, gathered by them from the mounds of the United States in the Ohio and Mississippi valleys. It went begging through the United States, knocked at the door of Congress, and besought a purchaser at the ludicrous price of $1000, but without finding a response. And in disgust with their countrymen, and in despair of ever being able to interest their Government or fellow-citizens, they sold their collection to England and retired from the field of archæologic investigations.

The National Museum courts the fullest investigations into its mode of conducting business. It is willing to be held to the strictest accountability for its expenditures. These should be made imperative. But it should receive at the hands of Congress an intelligent co-operation and a generous response to its efforts for the elevation and education of our people.

The Secretary of the Smithsonian Institution and Director of the National Museum has labored with all zeal to establish a zoological park and garden in the environs of Washington for the preservation and display of our native wild animals, now rapidly on the road to extinction. Looking in that direction, a few of these animals have been received as gifts under the promise that they would be protected and cared for. And they have been established in temporary wooden buildings, and a park, with a wire fence around it, as big as an onion patch, in the Smithsonian grounds, in expectation that they might form the nucleus of a future zoological park and garden. The House Committee on Appropriations seem to calculate or figure how much refuse meat, how many bushels of corn and bales of hay, how little of provision would support these animals, keeping them from starvation during the coming year, and so has reduced the appropriation by one-half from the estimates. One might suppose that the Secretary, meeting with such responses, would grow weary of his efforts in well-doing and retire from the further contest disappointed, if not in despair.

However, the people of the United States are not niggardly in

the matter of money needed for the benefit of science, if the object be properly explained and fairly understood. It rests upon the Secretary and Board of Regents to do this, and the people will justify them in asking for any reasonable amount so long as they shall be satisfied, as they may be under the present administration, that it is honestly expended and faithfully accounted for. Legislators seeking a reputation for economy will not be sustained by the people in refusing to vote the appropriations sufficient to secure, in these matters, a degree of excellence which will cause the United States to compare favorably with other countries.

Forgeries of Palæolithic Implements in Europe.—Mr. John Evans, of Nash Mills, Hemel Hempstead, England, the distinguished numismatist and prehistoric archæologist, says in a private letter lately received: "We have lately had very extensive forgeries of palæolithic implements in the neighborhood of London. Many of them are of great size and remarkably well made. Several collectors have been taken in, and I should not be surprised if some of our dealers exported a few to America. I recommend you to be on your guard."

Monsieur Boucher de Perthes, of Abbeville, the discoverer of the palæolithic age and implements in the valley of the river Somme, was often deceived by the workmen on whom he had to depend in his search for these implements. It was in the beginning of all knowledge of this subject, and no one could claim to be an expert or have much experience in their detection. Monsieur Boucher de Perthes stored his collection, if he did not make it a donation, to the Archæologic Museum of the town of Abbeville, and died without knowlege of the frauds of which he had been the victim. His son-in-law, M. D'Ault Dumesnil, the geologist, equally learned and practised as a prehistoric archæologist, became director of that museum. In the classification made by him of the palæolithic implements he detected the forgeries and withdrew them from exhibition. The United States National Museum has to thank him for a series which are there exhibited as specimens of these forgeries. So habile did M. Dumensil become in the detection of these forgeries that he was able to tell from an inspection of them, not only when they were forgeries, but from their peculiarities he could determine the identity of the forger. The "personal equation" was so manifested in this work as to enable him to do this.

International Congress of Prehistoric Anthropology at Paris, 1889.—The International Congress of Prehistoric Anthropology will profit by the French Exposition of 1889, and hold a meeting at Paris, in August of this year. These Congresses were organized in 1866–67, and have held their meetings in various capitals of Europe with greater or less regularity until the last one at Lisbon, in 1880. A session was organized for Athens, in 1883, but failed, owing to the rumors of approaching war. We are glad to hear of this revival at Paris for 1889.

A few individuals (I do not know whether they were enough to make it the plural number), living less that a hundred miles from the city of New York, having a greater desire for notoriety than to benefit the human race, attempted last spring and summer to organize a private international congress of prehistoric anthropology. The list of complimentary officers, Vice-Presidents, etc., was formidable, and comprised most, if not all, distinguished foreigners, and the farther away the more there were of them. The list appeared to have been copied from the records of some young and ambitious anthropological society, and to have contained all its honorary associates and corresponding members. The scheme was doomed from the beginning, as an international affair, for, while no anthropologists at home were consulted, or at least gave their adhesion, the time was too short to perfect arrangements with foreign countries and have their societies represented. But one foreigner of any note attended, and he—well, he concealed his disappointment with that suavity which belongs to his nation. No great harm was done to the science of prehistoric anthropology by the failure of this pretended International Congress, for no one was greatly deceived; but its instigators should take warning from this attempt and not repeat the fiasco. Think of getting up such a congress without the co-operation of any of the members of the anthropological section of the Association for the Advancement of Science, and without a representative from any of the anthropological societies of the United States except the local one interested.

Anthropological News.—Dr. A. B. Meyer, of Dresden, writes to *Nature* (XXXIX., p. 30) to state that there are no autochthonic Papuans or Negritos in Celebes, and to express doubts of their occurring in other islands to which they are attributed by Quatrefages and Flower.

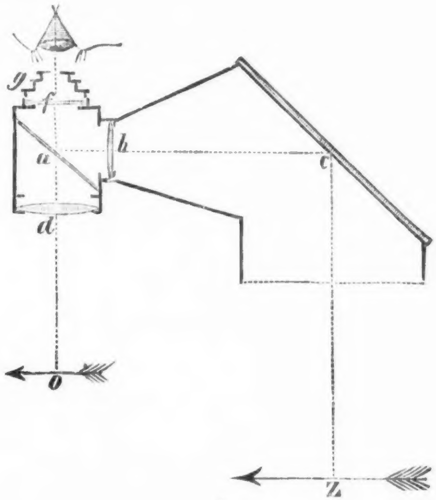
The first discovery of remains of cave-dwellers in Scandinavia has recently been made in a cave on a small island near Gottland. The remains consisted of the old fireplaces, and the bones of various animals, pottery, flint chips, etc. Most of the bones had been broken to extract the marrow. In the upper strata the bones of pigs, horses, etc., predominated, but in the lower those of seals increase.

During the past summer the museum at Copenhagen has explored a large kitchen-midden in Jutland, situated in a forest a couple of miles from the sea. Besides the usual assortment of bones and shells, many flint implements and fragments of pottery were found, as well as some bone and horn tools, a few of the latter showing traces of ornamentation.

MICROSCOPY.[1]

THOMA'S CAMERA LUCIDA.[2]—The cameras now in use are not well adapted for a low magnifying power (1–6), nor is any allowance made in their construction for the refractive index of the eye. In order to obtain sharp images one is often obliged to bring the drawing-paper nearer the eye, thus materially reducing the field of vision.

In the construction of Thoma's camera the above difficulties are avoided, and it is specially recommended for drawing with a magnifying power of from 1–10 times, and for the production of *reduced drawings.*



1.

The camera consists of a blackened, metallic frame containing two mirrors, one of which, fig. 1,*a*, is an unsilvered glass plate from 0.15 to 0.20 mm. in thickness, while the other (*c*) is a plain silvered mirror. Both mirrors are parallel with each other and inclined at an angle of 45° to the horizon.

In order to draw an object magnified four times, we place at *o* a convex eye-glass with a focal distance of 40 cm., and then fasten the camera upon the vertical rod so that the distance *b c* and *c z* = 40

[1] Edited by C. O. Whittman, Director of the Lake Laboratory, Milwaukee.

[2] Zeitschrift f. wiss. Mikroskopie, v. 3, p. 297, Sept., 1887.

cm. As the distance $b\ c$ is constant, 10 cm., $c\ z$ must be 30 cm., and may be easily found on the ruled rod that supports the camera.

Next a convex eye-glass of 10 cm. focal distance is inserted at d, and the upper end of the sliding ring to which the stage is attached brought within 10 cm. of the lower edge of the ring to which the camera is fastened.

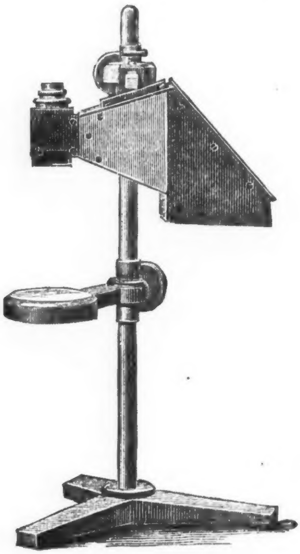
The amount of light is regulated by means of smoked glasses inserted above the convex glass at d.

If the eye of the observer is myopic, it is necessary to insert at f an eye-glass for correction. A myopic person will often find it convenient to use a glass a little stronger than is required in looking at distant objects.

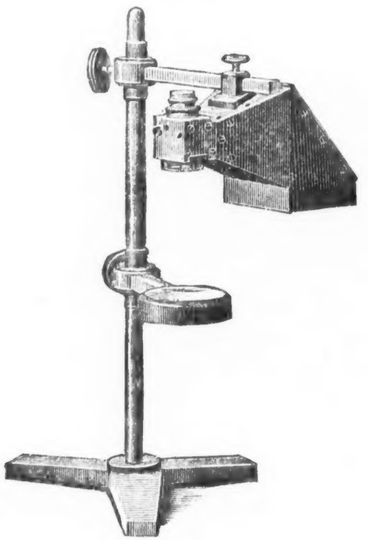
Finally, in all cases, except where a magnifying power of from 1 to 2 times is used, a diopter (g) must be placed above f. In using the high magnifying powers the focal points of both systems do not exactly coincide, so that a parallactic displacement of the images is produced, if the diopter is left out. This is a defect of all cameras and is usually corrected by the use of small prisms, while here the same object is equally well, and at the same time more conveniently, accomplished by the diopter.

The magnifying power is equal to the ratios of the distances. $b\ c\ z$ and $d = 40 : 10 = 4 : 1$.

In using the camera, it must stand before the observer, as in fig. 2, with the drawing on the right and the diopter and object on the left.

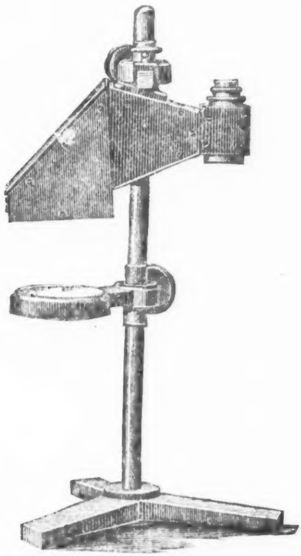


2.



3.

Only in using a magnifying power of from 1–1½ times is the position of the camera reversed, the drawing and object maintaining the same position as before (fig. 4). In this way we look directly at the drawing, while the object is seen through the two mirrors.



4.

For other powers than that given above, the following table may be used:

MAGNIFICATION TABLE.

I.

Diopter and object on the left, drawing and silvered mirror on the right, as in fig. 2.

Diopters of the convex lens necessary at *d* in fig. 1.	Smoked glass, No.	Distance of the object from the convex lens *d*.	Magnification	Diopters of the convex lens necessary at *b* in fig. 1.	Smoked glass, No.	Distance of the drawing paper from the convex lens *b*.
+ 15 = 10 + 5	c	66 mm.	6	+ 2.5	—	400 mm.
+ 12.5 = 12 + 0.5	c	80	5	+ 2.5	—	400 "
+ 10	c	100	4	+ 2.5	—	400 "
+ 10.5 = 10 + 0.5	c	95	3½	+ 3	—	333 "
+ 7.5	d	133	3	+ 2.5	—	400 "
+ 6.25 = 6 + 0.25	d	160	2½	+ 2.5	—	400 "
+ 5	d	200	2	+ 2.5	—	400 "

II.

Object and silver mirror on the left, diopter and drawing on the right, as required for a magnification of 1–1½ times, as in fig. 4.

Diopters of the convex lenses necessary at *b* in fig. 1.	Smoked glass, No.	Distance of the object from convex lens *b*.	Magnification	Diopters of the convex lens necessary at *d* in fig. 1.	Smoked glass, No.	Distance of the drawing paper from the convex lens *b*.
+ 5	—	200 mm.	1½	3.25=3+0.25	d	300 mm.
+ 4	—	250 "	1	+ 4=3+1	c	250 "

When in use the whole apparatus is placed upon the drawing-paper, which serves as the source of transmitted light, but reflected light may be used equally well.

One advantage of this camera is that, even with low powers, the field of vision is very large, so that objects from 6–10 cm. in diameter may be drawn. By placing the object in the place of the drawing, and the drawing in place of the object (using the above table), one can reduce the magnification from 1–⅙.

While it is easy by means of the concave glasses to accommodate any eye to the instrument, the apparatus is also a safe and convenient help in laboratories, even to the unexperienced. But as in all such instruments it is better to draw a ruler at the same time with the object.

If one who is able to see clearly with the above combination by inserting at *f* a concave glass of —5 diopters, then, since the distance of this glass rom the convex lenses is 3.8 cm., the concave lens may be omitted and the convex lenses at *b* and *d* replaced by others, 6.25 diopters smaller. With a concave glass of + 5 D. at *f*, it is possible to obtain a magnifying power of 8 times by inserting at *d*, 50 cm. from the object, a convex glass of + 20 D., and at *b*, a convex glass of + 2.5 D., 400 mm. above the drawing-paper. If the concave at *f* is omitted, then, leaving object and lens in same position as before, it will be sufficent to place at *d* a convex glass of + 20 — 6.25=13.75 diopters, and at *b* one of + 2.5 — 6.25= — 3.75 Ds. One may thus obtain an 8-fold power without using too strong glasses. For eyes of a different refractive index, the number of diopters to be deducted changes.

If in the previous combination it is necessary to have at *f* a concave glass of — 1 D., this may be removed by deducting 1 D. from the glasses at *d* and *b*.

In the same way,

A concave	glass of	— 2	D's at *f*,	may be	replaced by	— 2.16	D's at	*d* and *b*.
"	"	— 3	"	"	"	— 3.40	"	"
"	"	— 4	"	"	"	— 4,72	"	"
"	"	— 5	"	"	"	— 6.17	"	"
"	"	— 6	"	"	"	— 7.75	"	"
"	"	— 7	"	"	"	— 9.52	"	"
"	"	— 8	"	"	"	—11.50	"	"

If in the first named combination a concave glass of — 2 D. is

necessary at *f*, a myopic condition of — 8 D. may be produced if a convex glass of + 6 D's is placed in front of the one at *f*.

In the same way:

For an eye of		— 3 D's—	we must add			+ 5 D.
"	"	— 4	"	"	"	+ 4 "
"	"	— 5	"	"	"	+ 3 "
"	"	— 6	"	"	"	+ 2 "
"	"	— 7	"	"	"	+ 1 "
"	"	— 8	"	"	"	0 "
"	"	— 9	"	"	"	— 1 "
"	"	—10	"	"	"	— 2 "

in order to produce a myopic condition of — 8 D's. When this condition is produced, we may obtain higher magnifying powers, as follows:

III.

Diopter and object on the left, drawing and silver mirror on the right, as in figure 2.

Diopters of the convex lens at *d*.	Smoked glass, No.	Distance of the object from the convex lens *d*.	Magnification.	Diopters of the concave lenses at *b*.	Distance of the drawing paper from the convex lens *b*.
+7	d	57 mn.	7	—9	400 mm.
+8.5 =7.5+1	d	50	8	—9	400 "
+11 = 6+5	c	44	9	—9	400 "
+13.5 =7.5+6	c	40	10	—9	400 "

These combinations produce perfect images, except when the strongest magnifying power is used, when a slight distortion is visible on the edge of the field of vision.

The above described camera, together with a case of 25 glasses, may be obtained of R. Jung, Mechanic and Optician, in Heidelberg, for 120 marks.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Society for Psychical Research; Boston, Dec. 12, 1888.—Dr. J. W. Warren read the report of the Committee on Mediumistic Phenomena, of which the following is the substance:

"Your committee desires to report a moderate progress in the investigations pertaining to its work. During the year the committee, as such, has undertaken the careful examination of the results obtained by one well-known trance medium. We were aided very materially by the generous co-operation of the medium. Thus far we have been able to have only light on 10 sittings, stenographically reported. The results thus obtained are not of such a character as to warrant any very decided judgment as to the nature of the phenomena under examination, but they throw some light on the questions involved. An extension of the investigation would be very desirable, provided a sufficient amount of money could be placed at our disposal. As to materializing or etherealizing mediums, it is learned that seven—nearly every one of whom had been highly recommended to our special attention—have come to grief here in Boston during the past two or three years. Still, we are ready to examine these phenomena on the receipt of tangible experiences on the part of trustworthy persons, provided we are permitted to impose such conditions as seem to us reasonable and necessary."

Secretary Richard Hodgson read the report of the Committee on Thought Transference. In the experiments made by this committee, an attempt was was made to "will" the subject to name a number selected by the other party to the experiment. By pure chance, one might be expected to guess 10 numbers out of 100 correctly, but the results varied in each series of 100 from 10 to 28. Out of 3000 numbers selected, 584 were guessed correctly, instead of 300, which fact, the members of the committee think, points to some other influence than chance. It was noticed that when the right guess was made in the first place, the subject displayed no desire to change it, and it was only in cases where the first guess was wrong that the subject showed any uncertainty in announcing it, or attempted to change it afterward.

Prof. J. Royce read the report on phantasms and presentiments. He declared that, in his opinion, the methods of research adopted by the committee on phantasms and presentiments had been justified by the results obtained. After he had stated the subdivisions he had made of his subject, he gave his special attention to what he called "pseudo-presentiments" and to coincidences that seem to have some bearing on telepathy. Under the head of pseudo-presentiments he cited a number of cases where individuals, after events have happened, persuade themselves that they had presentiments of the events before they occurred. He also spoke of the feeling people often have, when visiting a strange place, of "having been there before." These hallucinations, he said, were attributable to surprises which make so strong an impression upon a man's mind as

to lead him to think that the subject has long had a lodgment in his brain. He spoke of three cases of telepathic coincidences, supported by documentary evidence, but these were all of them mentioned in his report of last year. These cases he considers very valuable for the purposes of the society, but as to the cause for them he expressed no opinion.

Dr. James made a short speech, setting forth the aims and needs of the society. It was the intention to extend the work of the society, and that specially interesting psychical cases in all parts of the country were to be scientifically investigated. Information in regard to alleged haunted houses was often received, many of which the society was unable to investigate, owing to a lack of funds, but there were over 700 cases now being investigated. The society, in self-defence, would be forced to publish more than it had ever done before, and all these matters required money. The new members, he said, had more than supplied the loss by withdrawals, so that the society was growing a little.

Biological Society of Washington.—December, 15, 1888.—The following communications were read: Prof. Lester F. Ward, "Fortuitous Variation as Illustrated by the Genus *Eupatorium*, with exhibition of specimens;" Prof. C. V. Riley, "Note on a Human Parasite;" Mr. E. S. Burgess, "*Aster shortii* near Washington."

December 29.—The following communications were read: Dr. Theobald Smith, "Contagion and Infection from a Biological Standpoint;" Mr. F. A. Lucas, "Notes on the Diseases of Menagerie Animals;" Mr. Th. Holm, "Notes on *Hydrocotyle americana* Linn.;" Dr. Cooper Curtice, "Notes on the Sheep Tick, *Melophagus ovinus* Linn."

SCIENTIFIC NEWS.

— Dr. G. Ruge, of Heidelberg, has been called to the Professorship of Anatomy at Amsterdam.

— The results of the explorations of the late N. M. Prjewalski in Central Asia are to be published by the Imperial Academy of Sciences of St. Petersburg, at the expense of the Crown Prince Nikolas Alexander. The first part of the first volume of Zoology has appeared and contains the Mammals by E. Büchner. Prjewalski was just starting on a new journey to Central Asia when his death occurred, Nov. 1, at Karacol. He belonged to a noble family and was born in 1839. His first Siberian journey was undertaken with ridiculously small means; it lasted thirty-four months and cost 6000 roubles ($4200). His second journey (1877) was under the auspices of the Russian War Department and resulted in the rediscovery of the Lob-Nor, which had not been seen by a single European since the days of Marco Polo. His third journey resulted in his discovery of the ancestor of the domestic horse (*Equus prjevalskii* Poliaeff). The fourth journey (1883) had for its objective point Thibet, and the fifth, on which he had just started when his death occurred, was an attempt to reach H'lassa, the sacred city of Lamaism. Prjewalski's natural history collections embraced 700 specimens of mammals, 5000 birds, 1200 reptiles and batrachia, 800 fishes, 2000 molluscs, 10,000 insects, and between 15,000 and 16,000 plants.

— Prof. A. C. Haddon, of Dublin, who sailed last summer for Torres Strait, has arrived there safely, and is engaged in studying the Sea Anemones, Nudibranchs, and the habits and placentation of the dugong or southern sea-cow. He is also collecting all the ethnological material obtainable, as the native population is rapidly dying out.

— The Copley Medal of the Royal Society is this year awarded to Prof. T. H. Huxley for his investigations on the morphology and histology of vertebrate and invertebrate animals. Baron Ferdinand von Müller receives the Royal Medal for his investigations of the Flora of Australia.

— The Costa Rican government has established a National Museum at San José.

— Samuel P. Fowler of Danvers, Mass., died Dec. 14, 1888, aged 88 years. He was a contributor to the AMERICAN NATURALIST in its early years.

— Prof. T. Kjerulf, the well-known geologist of Christiania, Norway, died in that city, Oct. 25, 1888

— Mr. Francis Darwin has been elected University Reader in Botany in the University of Cambridge in succession to Dr. Vines, now Professor at Oxford.

— Mr. Charles B. Cory, chairman of the Committee on Hypnotism of the American Society of Psychical Research, has issued his report. He believes that its use in connection with nervous diseases is worthy of consideration.

— Mr. H. A. Pilsbry is continuing the Manual of Conchology, Structural and Systematic, begun by the late Geo. W. Tryon. Part 39 of the first and Part 15 of the second series have recently been issued.

— G. Bellonci. Professor of Anatomy in the University of Bologna, died July 1, 1888, aged 30 years.

— G. Johann Kriesch, Professor of Zoologv in the Polytechnicum at Budapesth, died October 21, aged 54 years.

— Dr. Robert Lamborn has presented a cast of the *Phenacodus primævus* to the American Museum of Natural History, New York. He has also deposited a fine collection of Mexican antiquities in the Metropolitan Art Museum, New York, and a collection of Tuscan antiquities in the Museum of the School of Industrial Art, Philadelphia.

— Professor Joseph Leidy, of Philadelphia, has received the Cuvier prize of the French Academy of Sciences in recognition of his important work in Natural History.

— A work on the Extinct Mammalia, by Professors Scott and Osborn, of Princeton, N. J., has been announced by D. Appleton & Sons, New York.

— Mr. E. T. Dumble has been appointed State Geologist of Texas.

— Prof. J. T. Branner recently reported unfavorably on the supposed silver and gold mines of Arkansas, of which State he is Geologist. The abuse he received from the papers of the alleged mining regions was extraordinary and unparalleled, but when he offered to submit the question to the judgment of other geologists, they did not accept his challenge.

Two Interesting Models for Anatomical Studies.—Everybody who has visited the British Museum of Natural History in London has noticed the highly instructive anatomical preparations in the Central Hall of this wonderful building. A great part of these preparations are made by the very skilful hand of Mr. Richard S. Wray, B.Sc., one of Prof. Flower's assistants.

Besides these specimens Mr. Wray has prepared some very good models for the Museum ; two of these can be now obtained from him.

1. Model of Amphioxus, showing the general relations and dispositions of the organs as seen from the left side. Price, £2 2s. ($10, about.)

This is a reproduction of the original wax model forming part of the series of models and drawings prepared to illustrate the structure of Amphioxus for the Index Museum of the British Museum (Natural History). The different organs are distinctively colored, and the model shows at a glance all the more important anatomical relations of the animal. The disposition and relations of the central nervous system, notochord, alimentary canal (pharynx, liver, anus, etc.), the epipleural cavity with its backward extension towards the anus, the cardiac and dorsal aortæ, are all clearly shown together with other details.

2. Enlarged model of the left side of the lower jaw of a young Ornithorhynchus, showing the tooth germs *in situ*. Price, 10s. 6d. ($2.60, about.)

The following quotation from the label attached to the original preparation and model in the Index Museum of the British Museum (Natural History) will fully explain its nature :

"In the Ornithorhynchus teeth are absent in the adult,...... .... In the young state, there are, however, distinct tooth rudiments with calcified cusps, beneath the region in which the horny plates are afterwards developed.

"The small glass vessel contains the left side of the lower jaw of a young Ornithorhynchus, prepared to show the tooth germs *in situ*, the characters of which are more clearly shown in the enlarged model placed by it."

Communications relating to the above to be addressed Richard S. Wray, 23, St. Germain's Road, Forest Hill, London, S. E.

I can only recommend these highly instructive models to every student of Biology. G. Baur, New Haven, Conn.